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TWENTIETH ANNUAL REPORT

OF THE

STATE BOARD OF HEALTH

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OF

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1888–1889.

HENRY P. WALCOTT, M.D., *Chairman*, . .	OF CAMBRIDGE.
ELIJAH U. JONES, M.D., ...	OF TAUNTON.
JULIUS H. APPLETON, ...	OF SPRINGFIELD.
THORNTON K. LOTHROP, ...	OF BEVERLY.
FRANK W. DRAPER, M.D., ...	OF BOSTON.
HIRAM F. MILLS, C.E., ...	OF LAWRENCE.
THEODORE C. BATES, ...	OF WORCESTER.

Secretary.
SAMUEL W. ABBOTT, M.D.

Engineer.
F. P. STEARNS, C.E.

26649

CONTENTS.

OFFICE OF STATE BOARD OF HEALTH,
13 BEACON STREET, BOSTON, Jan. 1, 1889.

To His Excellency OLIVER AMES, *Governor*.

SIR: — I have the honor to present herewith the report of the State Board of Health of Massachusetts for the year ending Sept. 30, 1888, in compliance with the provisions of chapter 101 of the Acts of 1886.

Respectfully,

SAM'L W. ABBOTT,

Secretary.

GENERAL REPORT.

The following report of the State Board of Health comprises the work of the Board for the year ending Sept. 30, 1888, as provided for by the Act of 1886 creating the Board; and also a report of the operations and inquiries of the Board under certain special acts and resolves of the following years.

The report embraces the following topics: —

GENERAL WORK OF THE BOARD.

REPORT OF THE TRANSACTIONS OF THE BOARD UNDER THE PROVISIONS OF CHAPTER 375 OF THE ACTS OF 1888 FOR THE PROTECTION OF THE PURITY OF INLAND WATERS.

REPORT ON FOOD AND DRUG INSPECTION, REQUIRED BY CHAPTER 289, SECTION 2, OF THE ACTS OF 1884.

REPORT UPON TRICHINOSIS.

REPORT UPON THE OPIUM HABIT, REQUIRED BY A SPECIAL RESOLVE OF THE LEGISLATURE OF 1888.

BIOLOGICAL INQUIRIES AS TO THE QUALITY OF THE AIR IN HOSPITAL WARDS.

SUMMARY OF WEEKLY MORTALITY REPORTS.

HEALTH OF TOWNS.

The Board is composed of the following members: —

HENRY P. WALCOTT, *Chairman.*

ELIJAH U. JONES,	FRANK W. DRAPER,
JULIUS H. APPLETON,	HIRAM F. MILLS,
THORNTON K. LOTHROP,	THEODORE C. BATES.

The term of office of HIRAM F. MILLS expired in June, 1888, and he was reappointed for the term of seven years.

At the annual meeting held in June, 1888, the following officers were chosen: —

Chairman, ...	HENRY P. WALCOTT.
Secretary, ...	SAMUEL W. ABBOTT.

Under the provisions of chapter 375 of the Acts of 1888, FREDERIC P. STEARNS was reappointed as the Engineer of the Board, and JOSEPH P. DAVIS as its Consulting Engineer.

The following standing committees were also chosen: —

Finance. — Messrs. BATES and APPLETON.

Publications. — Messrs. WALCOTT, APPLETON and DRAPER.

Water Supply and Sewerage. — Messrs. MILLS, WALCOTT, LOTHROP, JONES and BATES.

Public Institutions. — Messrs WALCOTT, MILLS, JONES and BATES.

Food and Drugs. — Messrs. WALCOTT, JONES and DRAPER.

Legislation and Legal Proceedings. — Messrs. LOTHROP, APPLETON and BATES.

Health of Towns and Correspondence with Local Boards of Health. — Messrs. DRAPER and MILLS.

Contagious Diseases. — Messrs. JONES, WALCOTT and DRAPER.

Registration of Vital Statistics. — Messrs. DRAPER, WALCOTT and JONES

In addition to the duties prescribed by the organic act of 1886, by which the Board was reconstituted as a State Board of Health, certain other important duties were also defined by a later act of the same year, entitled "An Act to protect the purity of inland waters." This act was repealed by the enactment of chapter 375 of the Acts of 1888, which was substantially the same as that of 1886, the principal amendment consisting in the requirement that all cities and towns intending to introduce systems of water supply or sewerage should submit their plans to the Board for its advice, before the presentation of such measures to the Legislature.

The Legislature of 1887, by a special resolve (chapter 95 of the Resolves of 1887), provided that the Board should report upon the best method of effecting the sewerage and sewage disposal of the Mystic River valley, and of such cities and towns of the Charles River valley as they should

deem it best to include in the same general plan. The report of the Board upon this important question was submitted to the Legislature in January of the present year.

In addition to these questions, the Legislature of 1888 enacted a resolve providing for the investigation of the ice supplies of the State, with special reference to their pollution; and an order requiring the Board to investigate the subject of the use of opium, and to report upon these two questions in 1889.

Water Supply and Sewerage.

The law which was enacted in 1886, entitled "An Act to protect the purity of inland waters," has been quoted in full in the reports of 1886 and 1887. In 1888, after a thorough discussion of the operation of the law and the benefits secured to the people of the Commonwealth by its proper execution, it was deemed advisable to make the provisions of the statute more definite, and thus to give to the communities who were concerned in its operation greater protection, so far as their water supplies and systems of sewerage were concerned. An amendment was therefore made to the third section of the act, and the entire act is herewith presented, since it is one of the most important and comprehensive statutes which has been enacted for many years. The essential amendment is indicated by an italicized clause in the third section of the act.

[Chap. 375.]

An Act to protect the Purity of Inland Waters, and to require Consultation with the State Board of Health regarding the Establishment of Systems of Water Supply, Drainage and Sewerage.

Be it enacted, etc., as follows:

Section 1. The state board of health shall have the general oversight and care of all inland waters, and shall be furnished with maps, plans and documents suitable for this purpose, and records of all its doings in relation thereto shall be kept. It may employ such engineers and clerks and other assistants as it may deem necessary: *provided*, that no contracts or other acts which involve the payment of money from the treasury of the Commonwealth shall be made or done without an appropriation expressly made therefor by the general court. It shall annually on or

before the tenth day of January report to the general court its doings in the preceding year, and at the same time submit estimates of the sums required to meet the expenses of said board in relation to the care and oversight of inland waters for the ensuing year, and it shall also recommend legislation and suitable plans for such systems of main sewers as it may deem necessary for the preservation of the public health, and for the purification and prevention of pollution of the ponds, streams and inland waters of the Commonwealth.

SECT. 2. Said board shall from time to time, as it may deem expedient, cause examinations of the said waters to be made for the purpose of ascertaining whether the same are adapted for use as sources of domestic water supplies or are in a condition likely to impair the interests of the public or persons lawfully using the same, or imperil the public health. It shall recommend measures for prevention of the pollution of such waters, and for removal of substances and causes of every kind which may be liable to cause pollution thereof, in order to protect and develop the rights and property of the Commonwealth therein and to protect the public health. It shall have authority to conduct experiments to determine the best practicable methods of purification of drainage and sewage or disposal of the same. For the purpose aforesaid it may employ such expert assistance as may be necessary.

SECT. 3. It shall from time to time consult with and advise the authorities of cities and towns, or with corporations, firms or individuals either already having or intending to introduce systems of water supply, drainage or sewerage, as to the most appropriate source of supply, the best practicable method of assuring the purity thereof or of disposing of their drainage or sewage, having regard to the present and prospective needs and interests of other cities, towns, corporations, firms or individuals which may be affected thereby. It shall also from time to time consult with and advise persons or corporations engaged or intending to engage in any manufacturing or other business, drainage or sewage from which may tend to cause the pollution of any inland water, as to the best practicable method of preventing such pollution by the interception, disposal or purification of such drainage or sewage: *provided*, that no person shall be compelled to bear the expense of such consultation or advice, or of experiments made for the purposes of this act. All such authorities, corporations, firms and individuals are hereby required to give notice to said board of their intentions in the premises, and to submit for its advice outlines of their proposed plans or schemes in relation to water supply and disposal of drainage and sewage, *and all petitions to*

the legislature for authority to introduce a system of water supply, drainage or sewerage shall be accompanied by a copy of the recommendation and advice of the said board thereon. Said board shall bring to the notice of the attorney-general all instances which may come to its knowledge of omission to comply with existing laws respecting the pollution of water supplies and inland waters, and shall annually report to the legislature any specific cases not covered by the provisions of existing laws, which in its opinion call for further legislation.

SECT. 4. In this act the term "drainage" refers to rainfall, surface and subsoil water only, and "sewage" refers to domestic and manufacturing filth and refuse.

SECT. 5. Chapter two hundred and seventy-four of the acts of the year eighteen hundred and eighty-six is hereby repealed, but nothing in this act shall be construed to affect the expenditures authorized under chapter thirty of the resolves of the year eighteen hundred and eighty-eight.

SECT. 6. This act shall take effect upon its passage. [*Approved May 18, 1888.*

The operations of the Board, under the provisions of this act, have continued throughout the year, and the work accomplished in the different departments organized under the act has contributed harmoniously to the successful fulfilment of its purposes and ends.

The examinations of the waters of the various water supplies have been conducted continuously throughout the year, as in the previous year, but the knowledge already acquired as to the character and quality of such supplies has enabled the Board to adjust its work, so that the larger supplies, as well as those of questionable character, should receive an increased share of attention.

The experiments conducted under the provisions of the same act, having special reference to the effect upon water and upon sewage of intermittent filtration through different soils, which had been begun at the date of the last report and were the subject of a preliminary report, have been carried on through the past year and have rendered very material aid in solving some of the questions presented by cities and towns, acting under the provisions of section three of this act.

The department of chemical work has been under the

charge of Prof. T. M. Drown of the Institute of Technology, aided by a corps of well trained assistants. Mr. George H. Parker has continued the work of examination of the waters for the presence of the different microscopic forms of vegetable life.

The bacteriological work which had been conducted in the examination of the same waters by Dr. E. K. Dunham was continued by him up to September, 1888, when he resigned his position to fill a professorship in the Carnegie Laboratory in New York City, and then was carried on temporarily by Mr. G. R. Tucker until November, 1888, when it was reorganized under the charge of Prof. Wm. T. Sedgwick of the Institute of Technology. The operations of the Board under the provisions of this act, which (with the exception of the advice given to cities and towns, as required by the statute in question) were merely outlined in the report made in January (Senate Doc., No. 4, also presented in this report, pp. 1–44), will be fully detailed in a supplementary report or appendix, to be issued by the Board later in the year.

Sewerage and Sewage Disposal of the Mystic and Charles River Valleys.

The General Court by Resolve (chapter 95) of June, 1887, required the State Board of Health to consider and report a general system of sewerage for the relief of the valley of the Mystic River and a part of the valley of the Charles River, together with local sewerage systems for each of the towns not having such systems, that it might be seen how every part of all these towns could make use of the general system; and by chapter 63 of the Resolves of 1888 this Board was requested to designate some method for the disposal of the sewage of other cities and towns in the lower valley of Charles River.

The Board undertook with the aid of experts to make a thorough and complete solution of the great problem of how the sewage of this metropolitan district could best be collected and disposed of, for the present interests and future welfare of this portion of the State.

The method of solving these important questions, the organization of parties of investigators, the weighing of

evidence and reaching conclusions have occupied much of the time of the Board during the past two years.

The results of this investigation were presented to the General Court in January, 1889, in the report of the State Board of Health upon the sewerage of the Mystic and Charles River valleys, and published as Senate Doc., No. 2. The General Court has since ordered the construction of the systems of sewage disposal for these districts in substantial accordance with the plans recommended in the above report.

Infectious and Communicable Diseases.

Under the provisions of the general statute by which the State Board was created, it was authorized "to make sanitary investigations and inquiries in respect to the causes of diseases, and especially of epidemics, and the sources of mortality;" and by a further provision the Board was also empowered, in the event of an outbreak of small-pox or other dangerous infectious disease, "to investigate the same and the means of preventing the spread thereof." "Co-ordinate powers" with the local authorities were also conferred upon the Board. The Board has acted under the former of these provisions in such cases as have been referred to it. It has not, however, been deemed necessary in any case occurring during the past year to assume the authority conferred upon the Board by the latter of these provisions.

The following are some of the principal cases which have been deemed worthy of special inquiry: —

Small-pox. — The State has not been visited by an epidemic of this disease since the season of 1881–1882. The number of localized outbreaks in the State reported to the Board during 1888 was 17, and the whole number of cases was 32, with 5 deaths.

This number of deaths was greater than that of 1886 or 1887, but less than that of 1885.

The mortality from small-pox in Massachusetts for the past forty years has been as follows: —

The following Table exhibits the Mortality from Small-pox in Massachusetts for the past Forty Years.

YEARS.	Deaths from Small-pox.	Death-rate per 10,000 living.	YEARS.	Deaths from Small-pox.	Death-rate per 10,000 living.	YEARS.	Deaths from Small-pox.	Death-rate per 10,000 living.
1849, .	–	–	1863, .	42	.3	1877, .	24	.15
1850, .	334	3.4	1864, .	242	1.9	1878, .	2	.01
1851, .	117	1.2	1865, .	221	1.7.	1879, .	7	.04
1852, .	33	.3	1866, .	141	1.1	1880, .	38	.21
1853, .	38	.3	1867, .	196	1.5	1881, .	47	.25
1854, .	207	1.9	1868, .	20	.2	1882, .	45	.24
1855, .	325	2 9	1869, .	59	.4	1883, .	5	.03
1856, .	140	1.2	1870, .	131	9	1884, .	3	.01
1857, .	23	.2	1871, .	294	1.9	1885, .	19	.10
1858, .	12	.1	1872, .	1029	6.7	1886, .	0	–
1859, .	255	2.1	1873, .	668	4.3	1887, .	3	.01
1860, .	334	2.7	1874, .	26	.2	1888, .	5	.02
1861, .	33	.3	1875, .	34	.2			
1862, .	40	.3	1876, .	31	.2			

The cases occurred in the following nine cities and towns: Boston, Worcester, Springfield, Chicopee, Milton, Attleborough, Belchertown, Chester and Huntington. Six of the cases occurred in paper-mill towns, and of these four were among paper-mill operatives and their immediate families.

Fortunately the outbreaks were quite limited in the number of their victims, the greatest number taken ill at one place in a single outbreak being four. This immunity from an extension of the disease was undoubtedly due very largely to the prompt action of local boards in isolating the sick from the well and vaccinating those who had been exposed to the disease. Inquiry by the secretary of the Board has shown, however, that there are many unvaccinated persons in our cities and towns who would furnish abundant fuel for a serious epidemic, whenever the proper conditions might be presented.

The particulars relative to the cases which occurred were as follows: —

Record of Cases of Small-pox, 1888.

Number.	Place of Occurrence.	Date of Report.	Nationality.	Age.	Sex.	Deaths.	Employment.	Previously Vaccinated.	Number of Scars.
1	Milton, . .	Feb. 14,	English, . .	20 yrs.	M.	–	Paper mill,	Yes.	2*a*
2	Milton, . .	Feb. 29,	N. S., . . .	45 yrs.	F.	–	Housewife,	Yes.	1*b*
3	Boston, . .	Mch. 3,	Scotch, . . .	35 yrs.	M.	–	Seaman, .	Yes.	2*c*
4	Boston, . .	Mch. 3,	N. S., . . .	48 yrs.	M.	1	Seaman, .	No.	0
5	Huntington, .	Mch. 17,	Irish, . . .	17 yrs.	F.	–	Paper mill,	No.	0
6	Huntington, .	Mch. 27,	N. S., . . .	15 yrs.	F.	–	Paper mill,	No.	0
7	Worcester, .	Mch. 28,	Irish, . . .	16 yrs.	M.	–	Cigar maker, . .	Yes.	2*d*
8	Worcester, .	Mch. 28,	Irish, . . .	14 mos.	F.	–	– –	No.	0
9	Worcester, .	Mch. 28,	Irish, . . .	13 yrs.	–	–	Cigar maker, . .	Yes.	1*e*
10	Boston, . .	Mch. 31,	N. S., . . .	50 yrs.	M.	–	Seaman, .	Yes.	1*f*
11	Worcester, .	April 12,	N. S., . . .	5 w'ks.	–	–	– –	Yes.	1*g*
12	Boston, . .	April 20,	N. S., . . .	–	M.	–	Clerk, .	No.	0*h*
13	Huntington, .	April 23,	N. S., . . .	20 yrs.	M.	1	Farmer, .	No.	0
14	Chester, .	April 27,	– –	26 yrs.	M.	1	– –	–	–
15	Boston, . .	May 8,	N. S., . . .	15 yrs.	F.	–	House-maid, .	Yes.	1*i*
16	Boston, . .	May 8,	N. S., . . .	13 yrs.	F.	–	House-maid, .	Yes.	2*e*
17	Boston, . .	May 15,	N. S., . . .	72 yrs.	M.	–	None, .	Yes.	1*j*
18	Springfield, .	May 20,	Irish, . . .	6 yrs.	F.	–	– –	No.	–
19	Boston, . .	May 19,	Finland, . .	–	M.	–	Seaman, .	Yes.	2*k*
20	Belchertown,	May 22,	Irish, . . .	–	–	–	– –	?	–
21	Boston, . .	May 22,	N. S., . . .	3 yrs.	F.	–	– –	Yes.	–*l*
22	Boston, . .	June 2,	P. E. Island, .	21 yrs.	F.	–	Servant, .	No.	0*h*
23	Attleborough,	June 20,	Irish, . . .	23 yrs.	F.	–	Servant, .	Yes.	1*m*
24	Springfield, .	May 8,	Irish, . . .	8 mos.	M.	1	– –	No.	0*n*
25	Springfield, .	May 8,	Irish, . . .	25 yrs.	F.	–	Housewife,	–	–
26	Chicopee, .	July 9,	N. S., . . .	26 yrs.	M.	–	Cotton mill operative,	No.	–
27	Chicopee, .	July 23,	N. S., . . .	30 yrs.	F.	–	Cotton mill operative,	Yes.	1*o*
28	Chicopee, .	July 23,	N. S., . . .	25 yrs.	M.	1	Cotton mill operative,	Yes.	1*o*
29	Worcester, .	Aug. 18,	N. S., . . .	35 yrs.	M.	–	Expressman, .	No.	–
30	Springfield, .	Sept. 8,	French Canadian,	22 yrs.	M.	–	Carpenter,	?	–*p*
31	Worcester, .	Sept. 17,	N. S., . . .	6 mos.	F.	–	Father a driver, .	No.	–
32	Worcester, .	Oct. 17,	N. S., . . .	4 mos.	F.	–	Father a merchant,	No.	–

a Vaccinated seven or eight years since.

b Once when a child and also two weeks since, the latter not successful.

c Thirty years since.

d In childhood.

e In infancy.

f Caught from another seaman. Scar imperfect.

g Vaccinated after exposure.

h Contracted in New York City.

i Vaccinated ten years since. One imperfect scar.

j Seventy years since.

k In infancy. Contracted in New York City.

l Vaccinated at time of exposure. Contracted of No. 15.

m Arrived at New York City thirteen days before. Vaccinated in infancy.

n Vaccinated after exposure and two days before eruption of small-pox appeared.

o Vaccinated in infancy, and again on July 10.

p Says he was vaccinated in infancy, but shows no scar.

At the request of local boards, several of these outbreaks were investigated by the Board, especially such as occurred in paper-mill towns.

The first case reported was that of a young man in Milton, an operative employed in the dusting-room of a paper mill, in which were employed sixty-six operatives, forty-six men and twenty women. The rags used at this mill for paper-making were a mixture of foreign and domestic, in the proportion of about one-tenth of the former to nine-tenths of the latter. The domestic rags came mostly from New York and Brooklyn and the foreign from Königsberg in Eastern Prussia. About one thousand bales of domestic rags are used here yearly. This case was reported to the local board February 9, and on February 26 report was also received that the mother of the young man was attacked by the same disease.

Cases were also reported from Huntington on March 17 and 27, and on April 23. The two former were operatives in the paper mill in that town, neither of whom had ever been successfully vaccinated. In one of these cases the residence of the patient was in a very unfavorable location. The tenement where the patient lived was in the basement of a building, the first floor of which was used as a grocery store. This building was in the centre of the village, on a public thoroughfare. It was also next door to a church, and the village school-house was but a few rods distant. When first seen by the secretary of the State Board the patient was quarantined at this place and was too ill to be moved.

The conditions with reference to vaccination at this establishment (the paper mill) were quite fully described in the last annual report of the Board (pp. xix, xx).

The following account of the outbreak at Springfield is given by the health officer to the local board of health of that city: —

"An infant, eight months old, was vaccinated in Springfield on Monday, April 23. Wednesday, April 25, an eruption made its appearance. As measles had been very prevalent in the city, it was thought by the mother that the child had the measles. Sunday, April 29, the same erup-

tion appeared on the mother. Thursday, May 3, the child was so ill that a physician was called in. His visit was made about nine in the evening; that was the first time he had seen the child since the vaccination. His suspicions were aroused, but he thought it best to wait until the next day before making a diagnosis and reporting the case to the board of health. At one o'clock Friday, May 4, he reported the case to me, the child having died that morning at 9.30.

"I immediately visited the house and found the mother suffering from small-pox. The pustules indicated about the sixth day of the disease. As the day was raw and damp and the constitutional symptoms severe (pulse 130, temperature 104°), I deemed it unsafe to remove her to the pest-house. By a vote of the board of health the house was declared a hospital and thoroughly quarantined. A policeman is on guard day and night and no one is allowed to enter or leave the house but myself. To-day, the tenth, the pustules are umbilicating, the constitutional symptoms are less severe, and the patient bids fair to recover. As the house was open to the public for at least eight days after the eruption appeared on the infant, it is reasonable to suppose that a number have been exposed, mainly adults. I have vaccinated all I can find who have been exposed to danger of infection, and I trust no more cases will be developed, but of course I am anxious.

"Now, as to the cause. The appearance of the eruption two days after the vaccination is positive proof to me that the virus has nothing to do with it. Children vaccinated with points from the same package have developed a fine vaccine pustule in every primary case. There are numberless rumors as to the cause of the disease in this family, and the most plausible one is this: About four weeks ago a car used in transporting immigrants from Boston to Chicago was left in this city on its return. ——— ————, an employee of the Boston and Albany Railroad, cleaned this car. He said that before he had finished his work he felt sick at his stomach and vomited freely. I questioned him closely as to picking up anything in this car and taking it home; he says he did not. The family is a very quiet one; keeps no

boarders. One son only works; he is a clerk. The infant was about eight months old and nursed its mother. It undoubtedly died of confluent small-pox. There is a mystery I cannot understand, — why did they vaccinate this eight-months-old infant?"

Doubtful Diagnosis. — Cases occasionally occur in which the diagnosis is difficult, especially in the early stage of the disease. A case of this sort occurred in March, at Concord, Mass., in which the diagnosis was doubtful; but, on inquiry, it did not appear that the symptoms were sufficiently well marked to warrant a diagnosis of small-pox. At the time of investigation by the State Board the patient had died, and there were no appearances indicative of variola.

Other cases were reported from the town of Westport, in October. These consisted of five cases in one family, all French Canadians, their ages varying from three to nineteen years. At the time of the visit of the secretary these persons were all well enough to be about the house. Their symptoms were quite uniform, and none of them had been seriously ill, although two of the younger children presented no evidence of previous vaccination. Near by, on the other side of the street, were two other children, who had just recovered from an attack of illness which had been pronounced to be chicken-pox. It was therefore decided that all of the cases were merely chicken-pox.

In the preventive treatment of doubtful cases, error on the side of safety is preferable to mistaken diagnosis of an opposite character.

During the past few years, care has been taken by the Board, in its investigation of cases of this nature, to obtain all the evidence possible with reference to each case, by means of a circular, or blank form addressed to the Board, copies of which are forwarded to each town in which cases are reported. This circular, published in the Eighteenth Annual Report of the Board, has been amplified by the addition of further inquiries. Similar means are adopted by the German government to obtain information relative to outbreaks of small-pox in that country.

The circular comprises the required information specified in chapter 138 of the Acts of 1883, section 1, and also by

chapter 101 of the Acts of 1886, section 4, together with such other information as may aid in making a complete investigation of the case. Copies of the report or notice are sent in each case to the State Board of Lunacy and Charity, together with a statement as to the legal settlement of the patient.

In compliance with certain resolutions which were adopted at a conference of the State and Provincial Boards of Health held at Toronto in October, 1886, the different boards there represented have quite generally given notification of the prevalence of small-pox within the limits of their jurisdiction. Notices of the occurrence of small-pox in Massachusetts have also been sent out by this Board to "the Boards of Health of neighboring States and Provinces," as provided in the resolutions adopted at Toronto.

The cases which were reported to this Board, in compliance with the Toronto resolutions, occurred as follows: —

In January, 1 in Minnesota, and an epidemic (number of cases not stated) in San Francisco, Cal.

In February, 1 in Iowa, 1 in Tennessee, 1 in Louisiana and several in Kansas.

In March, 1 in Rhode Island, 1 in Pennsylvania (Philadelphia) and 10 in Maine. The first cases in Maine occurred in a paper-mill town.

In April, 2 in Illinois, 4 in Maine, 3 in Connecticut, 95 in Philadelphia, Pa., 1 in Louisiana and 1 in Minnesota.

In May, 112 in Philadelphia, and 2 in other places in Pennsylvania, 3 in Maine, 1 in Connecticut, 2 in Rhode Island, 3 in Illinois, 2 in Tennessee, 1 in Michigan and 1 in Montreal.

In June, 30 in Philadelphia, 7 in Illinois, 6 in Tennessee and 1 in Iowa.

In July, 113 in Philadelphia, 23 in Tennessee, 3 in Connecticut and 3 in Toronto.

In August, 29 in Pennsylvania, 3 in Illinois, 2 in Connecticut and 1 in Ohio.

In September, 11 in Pennsylvania, 3 in Minnesota and 5 in Toronto.

In October, 27 in Illinois, 5 in Toronto, 2 in Iowa and 1 in Montreal.

In November, 2 in Pennsylvania, 5 in Shefford County (Quebec) and 3 in Michigan.

In December, 12 in Michigan, 1 in Ohio, several in Iowa and in New York at Syracuse (number not stated).

There are certain points in the list of cases detailed on page xv which are worthy of special notice.

Age of Persons Attacked. — The age of 29 persons out of 32 attacked is stated, the age of the remaining 3 is unknown. These three were all adults. The average age of the 29 whose age is known was 21 years 5 months.

The average age of those who died — 5 in number — was a little less than 24 years.

No persons were attacked who were between the ages of 14 months and 13 years.

These facts, while comprising a very few individual cases, agree very closely with the results of foreign observations.

But little is known as to the average age of persons attacked in the period previous to vaccination. Statistics are given, however, relative to the average age of persons at death from small-pox.

Dr. McVail of Scotland, in an excellent paper in the supplement to the British Local Government Board Report for 1884, states: "The mean age at death from small-pox in the last century was two and one-half years, and is now nearly twenty years."

The contribution of the age period 0 to 10 years to 1,000 deaths from small-pox in the town of Kilmarnock in Scotland in the period 1728–1764, before the introduction of vaccination, was 988. In Geneva at a still earlier date it was 961.

The fact that cases of small-pox in the vaccinated are of rare occurrence until after the age of 12 to 15 years suggests the propriety of revaccination after a definite period. The present German law provides that all scholars must be vaccinated in their twelfth year, if they have not already had small-pox. The efficient enforcement of this law appears, from the recent statistics of the Royal Health Office, to have been very successful in keeping small-pox out of the Empire. The epidemics which have occurred have been confined mainly to the extreme north-eastern portion of the Empire, upon the Russian border.*

* See "Arbeiten aus dem Kaiserlichen Gesundheitsamte." 5. 1. page 37.

Small-pox, when it occurs unmodified by vaccination, as in the last century, is essentially a disease of childhood; it might almost be said of infancy. M. Marc d'Espine says of it: "The elective age of small-pox is childhood and infancy." It is as essentially a disease of children as scarlet-fever or measles. In the latter diseases a regular declining series is presented when successive ages are considered. For these diseases no method of prevention is known, and hence the statistics of mortality express unmodified natural affinities of such diseases for the earliest periods of life. For small-pox, since the introduction of vaccination, this declining series is interrupted in a most remarkable manner. The interruption is purely artificial, and is the expression of the effect of vaccination in postponing the greater mortality to a later period of life; and hence the necessity of revaccination.

The adjoining table expresses in four series of figures what may be taken as the expression (at least approximately) of the natural affinity of certain diseases. The population under five is a minority of the population (seldom more than fifteen per cent.), but it furnishes by far the majority of deaths from the diseases named — two-thirds of all deaths by scarlet-fever, four-fifths of all deaths by unmodified small-pox, and a still greater proportion of deaths by measles and whooping-cough. In a word, these are all distinctively infantile diseases; and the obviousness of this fact represents three conditions: First, that the susceptibility to those diseases develops itself very early in life; secondly, that the susceptibility, when once acted upon by its corresponding exterior cause, becomes exhausted more or less absolutely for the remainder of life; thirdly, that the exterior cause or infection has been of sufficiently frequent recurrence among the population for those relations of susceptibility to show themselves.

For the meaning of the diseases being infantile is not that any insusceptibility to contract them is acquired in the mere act of growing up, but that, because the susceptibility develops itself at the commencement of life, and because the exterior influence which acts upon that susceptibility is seldom absent, therefore all who have outlived the first year of childhood have commonly had each susceptibility exhausted by suffering the disease to which it relates. Hence, if all occurring cases of any such disease be classified according to the ages at which they happen, the resulting series of figures must necessarily have its maximum at that age when the special susceptibility is first fully developed. From this point it must undergo a more or less rapid and uninterrupted decline; the *uninterruptedness* being determined by the fact that at each succeeding age there will be fewer and fewer susceptible

persons, the *rapidity* being graduated by the frequency or constancy with which the exterior cause is in operation. (Report of the Committee on the Vaccination Act, London, 1871, p. 363.)

Proportionate Distribution by Age of 1,000 Deaths in Geneva by Small-pox (1580–1760), before the Discovery of Vaccination, and of the same number of Deaths by Whooping-cough, Measles, and Scarlet-fever, as observed in 1847.

Ages.	Small-pox.	Whooping-cough.	Measles.	Scarlet-fever.
0– 1, . . .	202½	404½	155½	63¼
1– 2, . . .	191½	275	346¾	145
2– 3, . . .	190	138½	201½	171¼
3– 4, . . .	132¼	77¾	117	153
4– 5, . . .	88¾	47¼	68	123½
0– 5, . . .	805	943	883¾	656
5–10, . . .	155½	52½	91¾	254½
10–15, . . .	18¾	2¼	13½	54¼
15–25, . . .	13¾	½	4	12¾
Above 25, . . .	7	1½	7	22½
At all ages, . . .	1,000	1,000	1,000	1,000

These figures show the affinity which small-pox (when allowed to pursue its natural course) bears to other diseases of childhood, in its relative destructiveness at the earliest ages.

That some cause has contributed in recent years to modify this effect of the disease upon different age-periods is very evident from the following tables, copied from the Report of the Medical Officer of the Local Government Board of England for 1884.

Contribution of Various Ages to 1,000 Small-pox Deaths at All Ages.

AGES AT DEATH.	Geneva 1580-1760.	Kilmarnock 1728-1764.	London 1848-1851.	Paris 1842-1851.	London-1884. Unvaccinated Community.	Vaccinated Community.	Total Inhabitants.
0–10, ...	961	988	815	397	612	86	343
10–20, ...	26.5	5	59	133	146	173	170
20–30, ...	10	7	83	329	108	319	213
30–40, . . .	2.5	–	32	110	72	221	142
40 and upward, .			11	31	62	201	132
	1,000	1,000	1,000	1,000	1,000	1,000	1,000

The inference to be drawn from this table is sufficiently plain, that the great change which has been wrought in the present century in the incidence of small-pox upon the population living at different age-periods is due to vaccination.

These remarkable results are corroborated in a very marked degree by more recent observations, and are especially shown in Dr. Barry's very complete report upon the epidemic of small-pox at Sheffield in England in 1887–1888.

Insusceptibility. — Comment is made by some of the observers contributing the reports of cases upon the occasional insusceptibility of people to vaccination. The majority of cases in the State during the year occurred in places more or less remote from the vaccine institutions or farms where vaccine lymph is produced, bovine lymph being at present the more common form of lymph employed in Massachusetts. The principal cause of apparent insusceptibility undoubtedly lies in the fact that the vaccinator too often knows nothing of the history of the lymph which he uses, especially with reference to its age. When vaccination is performed under the most favorable circumstances, with fresh lymph, from arm to arm, or from calf to arm in primary cases, insusceptibility is of rare occurrence. Cases

of inability to infect after repeated trials are often reported by physicians. Seaton says, however, that he has never met with any. Out of more than nine thousand vaccinations made at the Blackfriars Station of the National Vaccine Establishment, there was but one case in which vaccination was unsuccessful on a second trial. A third attempt was made in this case, and as the child was not brought back for inspection the result was unknown.

Dr. Robertson of Edinburgh says, in the "Twenty-fifth Report of the Registrar-General of Scotland:" "Constitutional insusceptibility, as expressed in the Returns, is virtually a confession from an operator that he has made three unsuccessful attempts to vaccinate a child without ascertaining the cause of his failures, and the fact that a child has a certificate of insusceptibility does not absolve its guardians from the duty of having the reality of the condition tested from time to time."

Dr. Cory also says, in his report to the Local Government Board for 1885, with reference to an experience with several thousand vaccinations: "In the whole course of my vaccination experience I have never met with a case of insusceptibility in any child under ten, and with only one case above that age, although it has fallen to my lot to vaccinate many cases of repeatedly insusceptible children."

(Dr. Cory's experience in later years has largely been concerned with bovine lymph, and in a later report of 1887 he states the number of primary vaccinations performed by him as 38,000, in only one of which did the operation prove unsuccessful.)

Vaccination after Exposure. — One observer, in his report to the Board, comments upon the uselessness of vaccination after exposure to small-pox. It is evident, however, that there is a period following such exposure, brief though it may be, in which vaccination should be performed, as determined by observations made during serious epidemics. Since the incubative period of vaccinia is shorter than that of small-pox by about three days, it is found that if vaccination is performed at any time within the first three days of exposure the vaccination will cause a certain degree of

modification of the small-pox, and consequent protection. If it is postponed to a later day no protection is afforded.

Marson states the case still more definitely, as follows: "Suppose an unvaccinated person to be exposed to small-pox on Monday: if he be vaccinated as late as the following Wednesday, the vaccination will be in time to prevent small-pox being developed; if it be put off until Thursday, the small-pox will appear, but will be modified; if the vaccination be delayed till Friday, it will be of no use, it will not have had time to reach the stage of areola, the index of safety, before the illness of small-pox begins" (Marson, in "Reynolds' System of Medicine," vol. i., p. 268). The only safe rule under all such circumstances is to *vaccinate immediately*.

In all such cases it is of the utmost importance that accurate observations should be made and recorded as to the date of exposure, the date of vaccination, and also the date of first symptoms of small-pox, should they occur.

Seaton also urges with propriety that the word "vaccinated" should not be used in certificates of death in which vaccination was merely attempted, but without any result. He also condemns in the strongest terms the practice of vaccinating after symptoms of small-pox have actually appeared in any given case presented for vaccination.

State Vaccine Institution. — In consequence of the constant immigration into Massachusetts, from foreign countries, of unvaccinated persons, and also in consequence of the frequent importation into the State of infected material from other States, our cities and towns are subjected to outbreaks of small-pox, which are only prevented from becoming serious epidemics by the greatest vigilance on the part of local authorities.

Vaccine lymph, which at such times is a prime factor in preventing the spread of the disease, is too often procured at long distances, and from middlemen, two elements which seriously interfere with its efficiency. Vaccine lymph, like milk, is an extremely perishable substance, and it is desirable to obtain it directly from the producer, at short notice, and in as fresh a condition as possible. There can be no doubt that in many of the cases which are reported as

insusceptible to vaccination, by local officers of health, the failure lies not in the persons vaccinated, but in the quality of the vaccine lymph employed for vaccination.

To obviate this serious difficulty, and to provide for the community the best possible protection, — that is, vaccine lymph direct from the heifer, from well-selected, healthy animals, — many of the cities of Europe provide vaccine stations, at which animals are kept for the purpose of vaccination, and for the sending of the lymph as fresh as possible to the public vaccinators. In some cities, the lymph is provided gratuitously, and in others a small fee is charged, to cover the cost of production. This plan is adopted in the principal cities of Germany, Holland, Belgium, Italy, and more recently in London. By this means the government authorities are enabled to guarantee to the community a lymph of reliable quality, and from reliable sources.

The establishment of one or more such institutions in this State would undoubtedly prove a valuable aid to the suppression of epidemics of small-pox. One institution might properly be located in the Connecticut valley, for several reasons, — the frequent occurrence of small-pox in the paper-mill towns of the Connecticut and Westfield valleys, the distance of those towns from the present private vaccine farms, and the facility of obtaining good and healthy stock for vaccine purposes from the surrounding agricultural region.

Diphtheria. — This disease has prevailed during the year with about the same severity as in the previous year. The mortality in Massachusetts from this cause for the ten years ending 1887 was as follows: —

YEAR.	1878.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.
Deaths from Diphtheria,	1,934	1,734	1,769	1,706	1,280	1,091	1,084	1,003	1,053	1,096

The Board was called upon several times during the year to investigate local outbreaks of the disease.

At Maynard in the earlier part of 1887 and in the summer

there had been a considerable prevalence of the disease. From April 1 to October 1 there was an unusual prevalence in the thickly settled part of the town, the whole number of cases amounting to seventy-five, with fifteen deaths. By request the secretary of the Board visited the town Oct. 7, 1887, and in company with the local board of health examined the principal village of the town with reference to its sanitary condition; he subsequently addressed the following communication to the local board of health: —

It would be out of place in this connection to discuss at length the causes of disease. It is sufficient to say that the spread of the two diseases in question (diphtheria and typhoid fever) is undoubtedly promoted by the presence of filth, and in a town of so rapid growth as Maynard, where wells used for drinking-water are located in densely populated neighborhoods, many must necessarily be in close proximity to vaults and cesspools, as I found them to be on the day of my visit.

It may not be possible to state definitely the cause of disease in any particular case, unless it be true that in certain cases of diphtheria the persons attacked were not sufficiently isolated from contact with others. This, however, appears to have been remedied by more careful measures adopted within the past few weeks.

In a town of the size of Maynard, a definite code of health regulations is desirable, and will be found a valuable aid to sanitary work; and, when once established, such a code should be carefully enforced.

My attention was also called to certain other matters; namely, the sanitary condition of certain parts of the town. The dumping-ground for refuse and night-soil, on the land of the mill corporation, while it was not offensive on the day of my visit, might readily become so at times when deposits of noxious material are made at that place. Upon more careful consideration I do not deem the present place, in the near neighborhood of inhabited dwellings, to be suitable for making such deposits. The condition of the drainage near the Maynard House, and that of the lowland between it and the main street, should also receive careful attention.

In response to a communication from the board of health of the town of Pittsfield, the secretary went to that town January 3 for the purpose of making inquiry relative to the

prevalence of diphtheria in Pittsfield during the previous month.

Pittsfield is located on the Boston and Albany Railroad, in Berkshire County, on comparatively level land west of the Hoosac range of mountains, at an average elevation of about 1,050 feet above the sea level. The population of the town was 14,466 in 1885 (State census). It has an excellent water supply delivered by gravity from mountain brooks rising in the towns of Washington, Hinsdale and Dalton. The water, like that of most of the Berkshire public supplies, is of excellent quality. The following is an analysis of this water for the past season: —

Water Analysis.

PITTSFIELD FIRE DISTRICT.

(PARTS IN 100,000.)

Number.	Date of Collection	Date of Examination	Color.	Residue on Evaporation. Total.	Residue on Evaporation. Loss on Ignition.	Residue on Evaporation. Fixed.	Ammonia. Free.	Ammonia. Albuminoid.	Chlorine.	Nitrogen as Nitrites and Nitrates.	Nitrites.
50	June 6,	June 8,	0.2	3.40	1.40	2.00	.0046	.0182	.07	.003	-
1338	Dec. 5,	Dec. 7,	0.45	3.35	1.35	2.00	.0055	.0183	.08	.002	None.
1340	Dec. 5,	Dec. 7,	0.1	6.50	1.25	5.25	.0011	.0101	.07	.010	None.
1339	Dec. 5,	Dec. 7,	0.3	5.90	1.10	4.80	.0019	.0144	.10	.012	None.
1102	Nov. 2,	Nov. 4,	0.0	6.80	1.00	5.80	.0000	.0024	.07	.012	None.

No. 50 from Ashley Lake above the dam, five feet below the surface.
No. 1338 from Ashley Lake. Streams all swollen by rain and snow.
No. 1340 from Ashley reservoir.
No. 1339 from Sackett Brook reservoir. Heavy rains and snow water for two days.
No. 1102 from tap in office of water board.

The sewerage of the town is partial only, and not extended to all parts of the town. The portion south of the railroad has a few sewers, the final disposal of the sewage being into the Housatonic River. The disposal of house sewage is mainly into cesspools and upon the surface.

About the middle of August, 1887, diphtheria appeared in the family of Mr. W. B. of Dalton. Mr. B. lived with his father at that time. The farm-house is on the road from Pittsfield to Dalton, and about three miles from the former and a mile or more from the latter.

They have a milk route, mainly in Pittsfield, for which purpose they own a dairy of fifty cows. The milk route is not a large one, about fifty families being supplied, and the remainder of the milk is used for furnishing cream to a creamery in Hinsdale.

The farm-house is not very old. It is two stories in height, of

ample size, and has a good cemented cellar under the whole house. It is furnished with an excellent water supply from a mountain spring, conveyed to the house by gravity. The sewage of the house is conveyed away from it, discharging at several rods distance. The plumbing and fixtures were being remodelled at the time of visit. They were apparently of an old and undesirable sort, the water-closet having been a pan closet, having an ordinary S-trap of lead. There had also been a trap at the cellar wall. Underneath one fixture, at least, — the sink, — there was no trap, and the water from it passed through the cellar in a thin metal pipe (zinc). The house was heated by steam brought from a steam boiler in the stable or dairy on the opposite side of the road. The water for the use of the family was first received in a tank of about 125 gallons capacity in the second story of the house, this tank being placed in a small closet. Water from the same source was conveyed by another pipe to the dairy.

The house of the other son, H. B., was situated at a distance of about twenty-five rods from that of his father. It is also a two-story farm-house of comparatively recent construction, and is heated by steam from a boiler in the cellar. The cellar is light, clean, cemented, and is used at present chiefly for the storage of vinegar. The water supply of this house is brought by a pipe from the same source as that of the other house. The water is received into a tank of about 170 gallons capacity. This tank is easily accessible, being located in a small room in the second story of the house, where water can be drawn directly from a tap if required for use on that floor.

The plumbing fixtures in this house consisted of a kitchen sink with trap at fixture, a bath-tub, water-closet (short hopper with trap above floor) and set bowl with trap. A portion of the pipes in the cellar for disposal of the waste were of thin metal, of loose construction.

The disposal of the sewage of this house was at a distance, in the valley of a water-course, at a much lower level than the house, and across the road.

The dairy is located in a collection of wooden buildings of various ages, on the opposite side of the road from the house of H. B., Sr. These buildings are used for various purposes, including the storage of hay, grain and ensilage, the stabling of the cows, horses and pigs, the making of cider, cutting and preparing material for ensilage. The milk and cream are all prepared for sale in the basement or cellar of the dairy. The milk is here placed in Cooley creamers, which are set in a tank of water to cool. These cans, as also the milk cans, are cleaned after they

have been used, by means of steam from a boiler which is located in another part of the cellar. The fifty cows are also stabled in the cellar, upon raised platforms. These cows were of various kinds, mostly natives, with some grade Jerseys and a few Holsteins. They were in good condition. The manure from these cows was received into a trench, where it was mixed with sand, sawdust or straw. The feed of these cows consisted of hay, ensilage, grain, middlings, and a mixture of corn-meal and gluten-meal. The ensilage (made of corn-stalks) was stored in three bins, one of which had just been emptied at the time of visit (January 4).

The water supply for the cows is obtained from a mountain brook which flows across the road and through the field near the dairy. The cows have access to this stream at several points. They also have access to a small tub of water in the yard.

Upon inquiry the following facts were ascertained relative to the outbreak of diphtheria at the B. farm in Dalton: Within the distance of a mile around the B. farm, which is in a sparsely settled farming district, between the towns of Pittsfield and Dalton, there occurred from July to December, 1887, inclusive, the following cases of diphtheria: —

At the house of H. B., Sr., Mrs. B. and 3 young children, 4 deaths; 3 other cases ill, including nurse and 2 young women (relatives).

At house of H. B., Jr., 2 cases.

At house of B., opposite latter, 2 cases.

(Making 11 cases at centre of infection.)

The following also occurred at Cranesville, a mile distant, in Dalton: —

F., boy, *died* about July 1. (Earlier than B. cases.)

C. 4 cases also in Cranesville in August.

P. 1 case also in Cranesville in September.

G. 1 case, fatal, one mile distant, in Pittsfield, in November.

H. 1 fatal case, one mile distant, in Pittsfield, in November.

E. 2 fatal cases, one mile distant, in Pittsfield, in November.

(Making 10 other cases within a mile, and 21 cases, including 9 deaths, within a mile, up to Jan. 1, 1888.)

In Pittsfield from Sept. 1, 1887, to Jan. 1, 1888, the cases were as follows: —

In September, 23; in October, 12; in November, 6; in December, 23. (Making a total of 64, and, in all, 73 up to Jan. 5, 1888.)

WATER ANALYSIS. — 1888.

(Parts in 100,000.)

Number.	Date of		Appearance.		Odor.		Residue on Evaporation.				Ammonia.		Chlorine.	Nitrogen as Nitrites and Nitrates.	Nitrites.
	Collection.	Examination.	Turbidity.	Color.	Cold.	Hot.	Total.	Loss on Ignition.	Fixed.	Odor on Ignition.	Free.	Albuminoid.			
1623	Jan. 18,	Jan. 19,	Clear. No sediment, .	0.0	None,	None,	7.20	0.30	6.90	None. White residue, .	.0000	.0006	.04	.015	Present.
1624	Jan. 18,	Jan. 19,	Clear. No sediment, .	0.0	None,	None,	7.40	0.75	6.65	None. White residue, .	.0000	.0004	.03	.018	Present.

No. 1623, from tap at sink in kitchen at H. A. B.'s. No. 1624, from tap at sink in kitchen at H. A. B., Jr.'s.

Of the twenty-three cases in December, fourteen occurred in eight houses, among people who took milk of the B.'s. Fifty families were supplied by them in Pittsfield.

This family (the B.'s) had two periods of illness, with an interval of three months (September 4 to December 10). The first attack was at the house of B., Sr. (July 5 to September 4), and caused three deaths. The father and younger son took care of the sick, leaving the care of the cattle to the other son. After the deaths, the carpets in the sick-rooms were burned, with all the bedding and part of the clothing of the attendants. Sulphur and carbolic acid fumigation was used freely, and articles used about the sick were burned as soon as they were soiled.

There were reported to the local board of health of Pittsfield during the year 1887, seventy-seven cases of diphtheria and twenty of scarlet-fever. These occurred as follows: —

Tabular Statement of Cases of Diphtheria, Scarlet-Fever and Typhoid Fever reported to the Local Board of Health of Pittsfield in 1887.

Month.	Diphtheria.	Scarlet-fever.	Typhoid fever.	Street.
January,	3	–	–	Beaver Street.
February,	1	–	–	Beaver Street.
February,	–	3	–	High Street.
March,	–	1	–	High Street.
April,	2	–	–	Wendell Avenue.
April,	–	1	–	Francis Avenue.
May,	1	–	–	Summer Street.
July,	–	2	–	Water Street.
August,	3	–	–	Second Street.
August,	1	–	–	Wahconah Street.
August,	–	1	–	–
September,	1	–	–	Burbank Hill.
September,	2	–	–	Coteville.
September,	6	–	–	Pontoosuc.
September,	2	–	–	Wahconah Street.
September,	2	–	–	Eveningside.
September,	4	–	–	Russell's.
September,	2	–	–	East part.
September,	1	–	–	Bradford Street.
September,	1	–	–	Circular Avenue.
September,	1	–	–	Boon's Avenue.
September,	1	–	–	Peck's.
October,	1	–	–	Reed Street.
October,	1	–	–	Allen Farm.
October,	1	–	–	Beaver Street.
October,	2	–	–	Burbank Hill.
October,	1	–	–	Russell's Block.
October,	4	–	–	Pontoosuc Block.
October,	1	–	–	Coltsville.
October,	1	–	–	Taconic Hill.

Tabular Statement of Cases of Diphtheria, Scarlet-Fever and Typhoid Fever reported to the Local Board of Health in 1887 — Continued.

Month.	Diphtheria.	Scarlet-fever.	Typhoid fever.	Street.
October, .	–	1	–	Railroad Street.
November, .	1	–	–	Belair.
November, .	1	–	–	Beaver Street.
November, .	–	1	–	Boon's Avenue.
November, .	3	–	–	John Street.
November, .	1	–	–	Fern Street.
December, .	–	5	–	–
December, .	2	–	–	Pontoosuc.
December, .	3	–	–	John Street.
December, .	1	–	–	Cottage Row.
December, .	1	–	–	Belair.
December, .	1	–	–	Wahconah Street.
December, .	1	–	–	North Second Street.
December, .	1	–	–	Prospect Street.
December, .	1	–	–	Bradford & Daniels.
December, .	–	1	–	Belair.
December, .	–	1	–	–
December, .	1	–	–	Daniels Avenue.
December, .	1	–	–	Henry Street.
December, .	1	–	–	Bradford Street.
December, .	3	–	–	South Street.
December, .	1	–	–	Church Street.
December, .	3	–	–	Prospect Street.
December, .	–	3	–	Wahconah Street.
December, .	1	–	–	North Second Street
December, .	1	–	–	Wendell Hall.
December, .	2	–	–	Union School.

Upon inquiry it appeared, as shown in the foregoing statement, that there had been cases of diphtheria at another village, a mile or two distant, at an earlier date than any of those which occurred at the B. farm. No very direct communication, however, could be traced, such as might be due to attendance at school or public gatherings of people. The families may have traded at the same country store, but nothing further could be learned.

From the statement of the local board of health of Pittsfield three persons were taken ill with diphtheria at the house of the elder B. in August, all of whom died, and a younger child was sent away to the house of some relatives to be cared for. A month later another fatal case occurred in the person of a child living about a quarter of a mile from this farm. About December 1, the child (grandson of the elder B.) returned home, together with two girls aged sixteen and eighteen, aunts of this child. All of these three persons soon after became ill with diph-

theria, and the child died. The younger aunt, being alarmed, went home, and was taken ill there with the same disease.

"To the north of the residence of H. B., at a distance of about four hundred feet, is the house of his son H., where the youngest son, youngest daughter and oldest son all were attacked with diphtheria. The oldest son drove the milk wagon, delivering milk to about fifty families in Pittsfield. Each of these children had typical cases of diphtheria. Across the road lived another family where two cases of diphtheria occurred late in December.

"Following up these facts, the following families in Pittsfield have had or now have diphtheria (December 29): K. M., two cases; one died December 27. H. B., one case. S. D., one. L., one. M. B., one. M., one. O., one. M., one.* In all, twenty-three cases, all of which used milk from the B. dairy. These are not all the cases we have had, but are those I have been able to associate with this milk route."†

After the funerals W. B. waited till September 26 before he resumed his milk route. He also waited some days before tending his cattle. During the illness his nephew C., at the other house, attended to the distribution of the milk at Pittsfield. H. B., Jr., usually reached his customers in the town after breakfast in the morning. In most places he used to leave the can outside and did not see the people. He says that in regard to those places where outbreaks of diphtheria occurred his practice was not different from what it was in other places. At one house milk was taken into the cellar and left. He usually bade the family "good morning." At another place he usually stepped into the kitchen, and occasionally saw the children. At another house he usually went into the kitchen. At another he never entered the house. At another he went in about once a fortnight. At another house, in which diphtheria attacked the family, he never went near the family, but the family obtained the milk of one of his customers, who invariably scalded the milk before sending it to the second family. At another house he occasionally entered the kitchen. At a boarding-hall he always took the milk into the kitchen, but never saw the man who was taken ill at this house.

The second attack at the house of the elder B. in Dalton occurred when an infant returned home, was taken ill December 10, and died in two weeks. The disease spread to the other farm-house; the wife at the second farm-house came over to the house of the older B., and may have carried the infection. The

* One more reported later in this family, making twenty-four.

† Statement of the local board of health.

two young women in this house were also taken ill, and also C., son of H. B., Jr. As soon as the disease reappeared, the Mr. B. living in the old house gave up his milk route to his nephew as before, stayed at home himself, and did not go out. The dairy work was attended to by the other brother, H., who was not in very close contact with his family. He occasionally saw his infant child, who was ill, but not severely. C. was kept confined to his room upstairs after he was taken sick, after which his father attended to the milk distribution. The business ceased December 27.

A few days after the visit of the secretary of the Board in January, Dr. D. F. Lincoln of Boston visited Pittsfield, at the request of the secretary, and made further inquiries relative to the sanitary condition of the houses of the families in which diphtheria had prevailed.

Nine houses were visited and examined, in which cases of diphtheria had occurred during the previous few weeks. The special points to which attention was directed were: the plumbing of the houses, where plumbing existed; condition of cellars, cesspools or sewers; material of sewer pipes; leaks at joints of pipes; condition of water-closets and traps.

In one case the plumbing was defective, the cellar damp; leaks at joints of drain pipe, which was of earthen-ware. The water-closet was an iron hopper, trapped, and without ventilation of trap; the water-closet trap also receives waste from set bowl. Sewage formerly backed up into cellar, but not at present.

In a second house the plumbing was good, the cellar wet, the air and ventilation of the rooms bad; deep cesspool, unventilated. Drain pipe of iron, joints not cemented; iron hopper water-closets, trapped and ventilated.

In a third house the plumbing was defective, the sewage disposal was into an unventilated cesspool; no water-closet; no traps found.

In a fourth, the sewage ran to a cesspool, unventilated, having one trap upon drain pipe.

In a fifth, the plumbing was good, the drain pipe was of iron, joints not cemented; a good water-closet, well trapped and ventilated.

In a sixth, the drain pipe was well caulked at joints; sink pipe trapped; privy vault over full.

In a seventh, the cesspool was very near the house; ventilated. Eight-foot drain pipe of iron; good joints.

In an eighth, there was a leak of the cesspool under the kitchen, with very bad odors. Cesspool in bad condition, unventilated, six feet from house. No traps anywhere.

In the ninth, the plumbing was generally defective, the old style of pan closets in use, and there were foul odors in cellar. Vent pipes from water-closets carried the air to chimneys; two of them ran through the room where patient was sick, and were in a loose, leaky condition.

The following comments may be made with reference to some of these cases: —

The cases at No. 2 were school children, and other causes may have existed.

In No. 5 the diagnosis was somewhat doubtful as to the character of the illness.

In No. 7 the milk was scalded before it was given to the child which was taken ill.

In Nos. 1 and 7 sewage had backed up, or leaked into or under the house.

In No. 9 the patient worked in a shop where there was said to be a nuisance close to him from an open drain.

Since some of the children attacked were in attendance at the Union Street school, an inspection of the school building was made. This school-house had been built about twenty-five years. It is of one story, and has two school-rooms of good size, well lighted. The air of the school-rooms and of the cellar has a "close" smell. The level of the ground water is about eighteen inches below the bottom of the cellar. In the spring it sometimes stands upon the surface or cellar bottom. The ventilation of the school-rooms is defective. The floors are warped and decayed.

The water-closets are in the middle of the building. There was said to have been some leakage from them into the cellar, but no direct evidence of it was to be seen. The sewage from these closets ran by means of a soil pipe to a cesspool about fifteen feet from the house. This cesspool was about ten feet deep, and its bottom was about five feet lower than the cellar bottom.

There is water in the cellar in the spring, but no proof that the contents of the cesspool flow back to the cellar.

The chief points requiring remedy in this school-house were the ventilation of both the school-rooms and the cellar, and improvement of the soil drainage of the cellar.

One case which occurred in December requires special attention, as having no probable connection either with local conditions or with the milk supply. A child living in Connecticut was said to

have died of bronchitis. The body was brought to Pittsfield for burial. The parents came with the body to a house in Pittsfield, and a public funeral was held. Within a week, and while the parents of the child still remained as visitors at this house, a child who lived in the house was taken ill with diphtheria and died. The parents of the first child said that the symptoms of this second child were just like those of their own. They also acknowledged that arrangements had been made with the physician in attendance upon the first case, to write a certificate of death by bronchitis, instead of diphtheria. Other cases of diphtheria followed in the same house. The occupants of this house did not take milk from the Dalton dairy.

The conclusions to be made from this outbreak may be stated as follows: —

The number of cases and of deaths from diphtheria which occurred at Pittsfield, while neither so numerous nor so fatal as to entitle them to the name of epidemic, yet presented certain features of interest worthy of notice.

Out of about three thousand families, the B. dairy supplied fifty, or one-sixtieth of the population. Out of an unknown number of cases, possibly 140, fourteen occurred on his milk route, or one-tenth of all the cases; that is, six times the due proportion, a fact having some importance when considered by itself, but also having much more weight when associated with the fact of the existence of the disease at the B. farm.

In the families supplied by B., having about 250 persons, of whom eighty were children under sixteen, eleven were taken ill with diphtheria, or about one-seventh of the whole.

The possibility of communicability of the disease by personal contagion, through the person or persons who delivered the milk, deserves consideration, and contagion by such a medium of communication appears more probable than that which might occur through the medium of the milk itself.

The persons who delivered the milk occasionally met the members of the families to whom the milk was furnished, sometimes meeting one person and sometimes another.

The question of the effect of defective drainage and sanitary conditions might be deemed to have greater weight in the consideration of the causation of diphtheria in this instance, if it were not known that similar conditions may be found in too many houses which diphtheria has not invaded, a fact which unfortunately is not peculiar to Pittsfield.

Another point of interest which arose in connection with this question was the following: The dairy at the B. farm supplied cream to a creamery in an adjoining town, and the question was asked of the State Board, early in January, whether it would be safe to use the cream for the purpose of making butter.

Reply was sent, that while the conveyance of diphtheria through the medium of butter was not a matter of probability (no evidence existing to show such a mode of contagion), it could not be considered as impossible. The water supply, drainage and heating of the two farm-houses was much better than that of the average farm-house. Defects in the plumbing, however, did exist, which were being remedied at the time of visit. Two weeks or more had elapsed since the termination of the last case of illness, and disinfection had been practised. Considering these facts, it was advised that the use of the cream from this dairy, for the making of butter, should be deferred until a date not earlier than February 1.

Lynn.— Several cases of diphtheria of an unusually severe type occurred at Lynn in April, 1888, to which the attention of the State Board was directed by a request from the board of health of Lynn. On inquiry it appeared that the first case was that of an infant child, which was taken ill about April 21 and died April 27. A brother of this infant was sent away from home April 23, and was taken ill April 26 and died April 30. Two adults who had assisted in the care of these children were taken ill, one on April 27 and died May 1, and the other on April 29 and died May 4.

Measures were taken by the local board of health for the disinfection of the houses where these cases occurred, and no other cases followed them in those localities. With reference to their origin, careful investigation was made as to the sanitary condition of the houses in question, and nothing was apparent which would warrant a suspicion of local causes. It was, however, learned on further inquiry that a wet nurse was secured for the baby on the twelfth day of April. She came on that day, made a short call, returned to Boston, and came again late on the following day (13th). The child was taken ill about the 21st of April, the disease not being well pronounced until the 24th.

It appears that this nurse boarded, in common with others,

at a house in Boston where wet-nurses were waiting for employment, and that a child was taken ill at that house with diphtheria, and died there on April 12th, the same day on which the nurse was called to Lynn. A letter from the attending physician confirms this statement with reference to the case of the child who died in Boston April 12 : —

The case was both rapid and malignant, the child living less than two days from the time of my first visit.

These facts would point very strongly to personal contagion, or rather the conveyance of infection through the medium of a third person, as a cause in this instance, and seem to convey an additional lesson as to the importance of taking the most careful precautions in every case to prevent its further spread from the sick to the well.

Scarlet-fever. — Scarlet-fever has not prevailed to an unusual degree in 1888. The mortality from this cause in Massachusetts during the past twenty years has been as follows : —

1869 — 1878.

Year.	1869.	1870.	1871.	1872.	1873.	1874.	1875.	1876.	1877.	1878.
Deaths, . . .	1,405	683	867	1,377	1,472	1,382	1,684	1,222	467	404
Death-rates per 1,000 living, . . .	9.9	4.7	5.8	8.9	9.4	8.6	10.2	7.4	2.8	2.4

1879 — 1888.

Year.	1879.	1880.	1881.	1882.	1883.	1884.	1885.	1886.	1887.	1888.
Deaths, . . .	850	574	397	318	575	627	587	331	594	504
Death-rates per 1,000 living, . . .	4.9	3.2	2.2	1.7	3.5	3.3	3.0	1.7	2.9	2.5

The prevalence of scarlet-fever and its consequent effect upon the death rate has been much less in the last ten years (1879–88) as compared with the previous decade (1869–78).

If this decrease in mortality (the principal share of which falls upon children under ten years of age), is not due en-

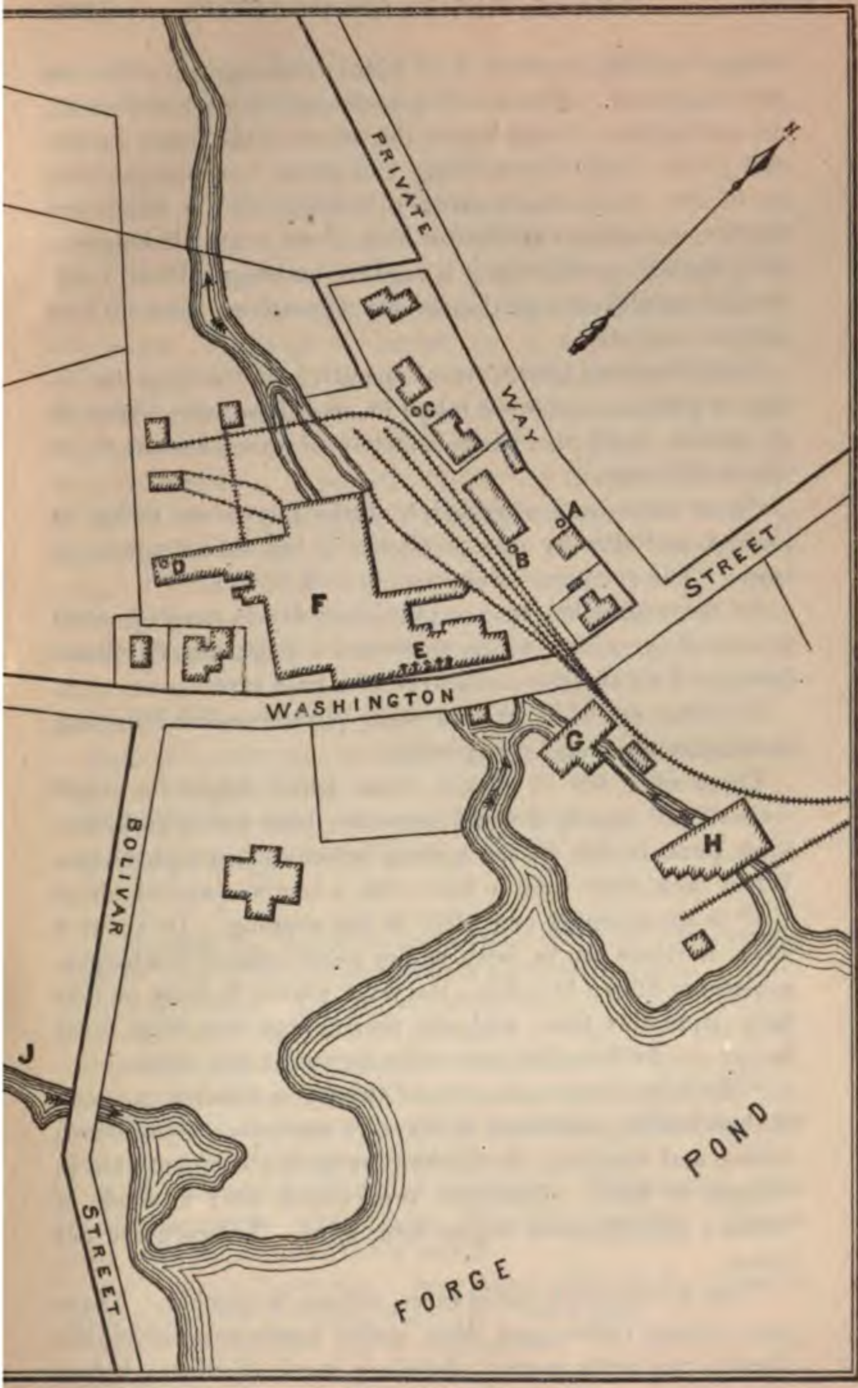
tirely to a better understanding among the people of the methods of prevention, it is fair to presume that a considerable portion of the decreased death rate is due to this cause, as well as to the enactment of more efficient laws for the prevention of infection, especially among school children, and also to the energetic action of local sanitary authorities. In the report on the mortality of the State (page 253), it is shown that the mortality from this cause is least in those summer months in which the schools are closed and one of the main avenues of infection is thus cut off.

There were no extensive epidemics from this cause reported to the Board, and the only case in which the Board was called upon to make an inquiry with reference to this disease, was that of the town of Mashpee, formerly an Indian settlement on Vineyard Sound, but latterly given authority to adopt a town government.

The population of this town was 311 in 1885 (State census). There had been no deaths reported from scarlet-fever in the town for nearly twenty years, until December, 1887, when an adult female, aged 29 years, was attacked, the disease proving fatal. From this time until March 1, there were but few cases and no fatal cases. Other cases were taken ill in March, and from that date until June there were more frequent cases, the whole number of deaths being eight.

The town has no separate board of health, and, in some cases, proper precautions had not been taken with reference to the prevention of the spread of the disease, such as requiring that all funerals in cases of deaths from this cause should be private, and other similar precautions. The Secretary visited the town, conferred with the selectmen, and furnished such circulars and other information as appeared to be necessary. No further cases have occurred since June, 1888.

Typhoid Fever. — The Kinsley Iron Works is located upon a branch of the Neponset River in the town of Canton. It is an old and well-established corporation, employing about two hundred men. The greater portion of the operatives, one hundred and twenty in number, are employed in



Kinsley Iron Works. Canton.

a large building (marked F on plan) covering more than an acre of ground. This building is situated below a mill-dam, the ground-floor being below the level of the water in the mill-pond. Near this building and above it, across the outlet of the mill-pond, is another building (G) in which are employed a smaller number of men, about twenty in number. Still farther up the stream is another building (H) in which are also employed a portion of the operatives, some fifty or sixty in number.

Early in June, 1888, several operatives in the large building, or punch-room, were taken ill, and these were followed by others, until the whole number of cases amounted to about fifty men.

These cases were attended by three physicians living in Canton, and also by one physician living in an adjoining town. The symptoms were mainly as follows:

Of those attended by one physician, five in number, none presented symptoms which warranted a diagnosis of typhoid fever, and all of these cases were of a mild type.

Of those attended by two other physicians the following statements were made conjointly:

There were ten or eleven cases, which might be called "abortive," equally divided between these two physicians. Such patients felt ill for a week before calling a physician. When seen, they were in bed, with a temperature of about 101° in the morning and 103° in the evening. In about a week diarrhœa set in, with yellow ochre-colored discharges, sometimes fifteen in a day; the fever abated in three or four days from this time, and the patient was free from fever in two weeks from the time when he was at first seen.

"Walking" cases, nineteen or twenty in number, not seen at their houses, recovered in seven to ten days. Symptoms: nausea and vomiting; headache prominent; frequent pain in occiput or back. Diarrhœa supervened after a week of illness; convalescence began soon after. Temperature not taken.

Fully developed typhoid cases, sixteen in number. These were about twenty-one days under treatment before the disease was quite normal, beside a week of illness before they were seen. During the preliminary week there was

headache, pain in the back, constipation. Off work several days before consulting doctor. When seen, appeared sick in bed, as if about to have typhoid fever; "played out"; hands tremulous; and most of them delirious (muttering, not noisy), by day and night, for a week and later. Diarrhœa supervened about the thirteenth to the sixteenth day of treatment; not obstinate; lasted a day or two, bringing no improvement in general symptoms. Tympanites marked in five cases. Soreness or tenderness in right iliac region in most. No bloody stools. Epistaxis in first week of attendance in nearly all. (Vesicular eruption, followed by slight pustulation in one case, sixteenth day, and drying up without crusts.) Temperature 101° in the least feverish, 104½° in the most feverish case; highest on eighth to ninth day of attendance. Pulse below 80° in first week; not over 110° at all; and highest in the second or third week. Abundant sweating a marked symptom. No miliary vesicles. Sordes of tongue in most or in all the cases. One case of hemorrhage of bowels, with clots; tongue thick, creamy and tremulous.

Rose-spots fifteenth to sixteenth day, lasting two or three days, in all but twenty-one.

Dr. D. F. Lincoln, who examined some of these cases, reports their appearance on the day of their examination as follows: —

T. D., aged 20. About the thirtieth day of illness. Appearance decidedly that of a typhoid patient in a well marked case. Sordes on lips and teeth. Tongue, in middle, bright red; the rest covered with white flakes; soft; tremulous. Voice weak and slow, but answers correctly. Hebetude of expression. Respiration, 30. Rash, "resembling measles," on face and trunk; red and confluent, some time ago, with miliary vesicles. (This man had had several intestinal hemorrhages.)

E. M. Twenty-second day of observation. Temperature, 101°, A. M.; respiration, rapid; pulse, 96; much sweating. Tongue with white creamy coat, red in middle.

J. M. Seventeenth day. Less fever than E. M. Tongue tremulous, white in middle, edges red; facies good.

M. C. Twenty-first day of observation. Not much different from J. M. Had eruption resembling indolent superficial boils, beginning sixteen days ago and not yet ended.

—— R. Same day of observation. Constipated all the time; pimples on face; pulse, 72; tongue white, red in middle.

Most of the cases have passed the severest stage of their illness.

The patients here reported were all working in the iron works (except one, who was a water-cart driver, but used water from the works).

The secretary of the Board visited Canton on the 5th of July and inspected the locality, including the iron works and their surroundings. At the time of this visit, about fifty of the men employed at the works had been taken ill and one had died.

The men who were taken ill were nearly all employed in one of the buildings of the works, the large punch-room, covering an acre or more of ground. Only one man employed in the upper building had been taken ill, and his case was not a well-defined case of typhoid fever.

None of the women or children of the families of these men were taken ill.

These facts appeared to exclude any causes which might exist at the homes of the men employed, such as the sanitary surroundings of the houses of the operatives, their food, milk or water supplies, and suggested an examination of the works and their surroundings, and especially of the larger building in which the men who were taken ill had been at work. It has been stated that the men employed in the upper foundry were not taken ill, except one man whose case could not be considered as a typical one. The water supply for the men employed in this building was a well at some distance, near an old and disused stable.

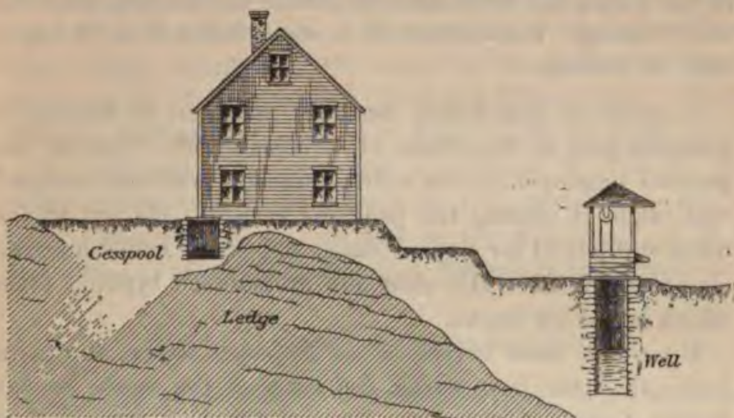
The water supplies for drinking purposes used by the men in the other buildings were as follows: —

1. A well at the foot of the rising ground upon which the office stands. This was the principal water supply for the operatives, and was used at some time or other by all the men who were taken ill. (Marked B on plan.)

2. The water of the pond, which is used for power to run the hammers. A small stream is let into the works at the side of each hammer and is often used for drinking-water by the men. (Indicated at E on plan.)

3. A barrel sunk in the ground, in a corner of the works, its top being level with the ground. This was used for drinking-water to some extent. (At D on plan.)

The well (1) is situated by the side of the roadway, a few rods distant from the stream which is the outlet of the mill-pond. It is near a building used for the storage of oil and sand. The well is about twelve feet deep, and at the time of visit contained six feet of water. The office of the company is at the top of a slight terraced eminence, about six feet in height. At one corner of the office is a water-closet, the discharge of which runs into a cesspool on the top of the hill, a few feet from the building. This cesspool is five and one-half feet deep, its bottom being above



the level of the ground near the well, and six feet or more above the level of the water in the well at the time of visit, and is not water-tight. The distance between the cesspool and the well is fifty-four feet. Between the cesspool and the well is a ledge of coarse granite, which rises nearly to the surface of the ground on the line between the cesspool and well. It also stretches between the two buildings, the office and storehouse, and may be seen in the cellar wall of each building. This ledge was examined at several points by digging down to it. The soil about the cesspool is loose and porous, its character being shown by the fact that, although five persons use the water-closet, the cesspool, which is not large, and had not been cleaned out for several months, had but five inches of water in it. The water had disappeared in some direction. The natural direction of the underground flow of water would be down the hill toward the stream, or mill-pond outlet, and also in the direction of the well, if not obstructed by the ledge.

2. The water of the pond. At some distance above the iron works a stream (J) enters the mill-pond, which is largely polluted by the discharge from the water-closets of silk factories located on the stream, these closets being directly over the water as a matter of convenience. These factories employ a large number of operatives. There had been no cases of typhoid fever among these operatives, and in fact the disease had been of very rare occurrence in the town outside the iron works. This water was not very largely used by the operatives for drinking purposes.

3. The water-barrel or spring (D) in a corner of the punch-room. This water supply, used to some extent for drinking, was in a dark corner, liable to pollution from its location on the floor of the works, and also from filth outside the building, near this well or spring. The analysis of its water shows it to be totally unfit for drinking.

A point of importance deserves mention, as forming a probable part of the chain of circumstances. One of the persons employed in the office connected with the cesspool was taken ill during the previous season. He was at the office and felt ill for several days, and finally called a physician October 22. His case was pronounced typhoid fever which lasted six weeks.

Upon the same branch of the Neponset River, at a point lower than the iron works, are situated the works of the Revere Copper Company. None of the men employed at these works were attacked with illness during the period in question (the months of June and July, 1888). It should be stated, however, that these men did not use the water of the river for drinking.

A consideration of these facts seemed to point very strongly toward the well as the source of the trouble. Several analyses of the water of this well were made, both at the request of the local board of health and also of the State Board, and by different chemists.

None of these waters would be considered as fit for drinking purposes, if judged by the analysis alone. The proximity of the cesspool to the well, its position at a higher level, the fact that but little water remained in the cesspool after continuous use, the existence of a previous case of typhoid fever in the person of one of the occupants of the office, and the outbreak among the persons who used the water of the well and almost exclusively among them (there had been scarcely

a case in the town during the year outside of these works), rendered it desirable to test the possibility of a communication between the cesspool and the well. The experiment recommended in Prof. W. R. Nichols' excellent treatise on Water Supply (p. 132) was tried. This experiment consists in using common salt to test the permeability of the soil. The water of the well having been subjected to analysis, the results obtained from four analyses showed a variation of .19 of one part in 100,000 of chlorine; the average of four samples showing 1.54 parts in 100,000. Immediately after the last of these samples was taken (July 12), a bushel of common salt was put into the cesspool and mixed with the sewage deposit contained therein. After waiting a reasonable time (one week), samples of the water of the well were taken again on the 19th, 21st, 24th, 26th and 27th of July. These samples indicated the presence respectively of 2.36, 2.82, 2.78, 2.54 and 2.66 parts per 100,000 of chlorine in the water of the well, or an average of 2.63 parts; thus showing an increase of the chlorine in the well-water of 70.8 per cent., following the placing of the salt in the cesspool.

Analysis of Waters used at the Iron Works.

[Parts per 100,000.]

Number.	Date of		Residue on Evaporation.			Ammonia.		Chlorine.	Nitrogen as —	
	Collection.	Examination.	Total.	Loss on Ignition.	Fixed.	Free.	Albuminoid.		Nitrates.	Nitrites.
	1888.	1888.								
1	June 13,	-	20.70	8.60	12.10	.0018	.0066	**1.67**	-	-
2	June 30,	-	-	-	-	.0030	.0068	**1.48**	-	.0010
3	July 5,	-	-	-	-	.0014	.0044	**1.48**	.6000	.0000
4	July 12,	-	21.10	8.85	12.25	.0002	.0082	**1.54**	.6000	.0001
5	July 19,	-	-	-	-	-	-	**2.36**	-	-
6	July 21,	-	-	-	-	-	-	**2.82**	-	-
7	July 24,	-	-	-	-	-	-	**2.78**	-	-
8	July 26,	-	-	-	-	-	-	**2.54**	-	-
9	July 27,	-	-	-	-	-	-	**2.66**	-	-

Other Waters used at the Iron Works.

10	July 5,	July 6,	3.90	1.55	2.35	.0046	.0274	.44	.0070	.0000
11	July 12,	July 13,	30.50	10.50	20.00	.0012	.0086	2.46	.1800	.0010
12	July 27,	-	-	-	-	-	-	2.34	-	-
13	July 12,	July 13,	65.40	14.95	50.45	.0042	.0128	18.76	.8000	.0004

Nos. 1, 2, 3, 4, 5, 6, 7, 8, 9, are analyses of the water of the well (B) chiefly used for drinking-water. (Nos. 5, 6, 7, 8, 9, were taken after the salt had been put into the cesspool.)

No. 10 is the water of the mill-pond taken at a tap inside the works. (E.)

Nos. 11 and 12 are from a well outside the yard, used after No. 1 was discontinued. (C.)

No. 13 is from the spring in the floor of the punch-room. (D.)

No. 10 had considerable color; the other samples had no color.

As a further measure of inquiry a biological examination of the water of the well was made by Dr. H. Jackson of Boston, Aug. 6, 1888. Samples of water were taken, which were drawn up from the well by the bucket, and from these samples plate colonies were made.

The report of this examination states: "Several suspicious looking colonies were found; but on testing them, by making plate cultures, I found them all to be non-pathogenic forms, found in all waters.

"August 11, I made a second visit to Canton and took water directly from the well by means of a sterilized bottle. Five sterilized flasks were filled and from each flask two plate cultures were made, each with one drop. The plates all showed a growth of bacteria very similar in character and in the number of the colonies. The average number of the colonies was forty to fifty. Macroscopically the colonies were as follows: four to eight liquefying colonies; ten to twelve prominent yellowish brown colonies. The larger part of the colonies were prominent semi-opaque porcelain white growths.

"It was evident from the macroscopic appearance that none of these colonies were the bacillus of typhoid. In each plate a few small white colonies were found, slow in growth, that macroscopically were similar to the typhoid growths; but the plate test showed that none of them were the typhoid bacillus. The number of colonies averaged one thousand to the cubic centimeter. No bacilli of typhoid fever were found. (The number of the colonies does not indicate that the water of the well was markedly contaminated by sewage.)"

Respectfully yours,

HENRY JACKSON.

But little importance should be attached to this biological examination, from the fact that it was not made until two months after the first outbreak of illness and several weeks after the use of the water had been discontinued, and also not until after the water of the well had been thoroughly pumped out (and had been renewed at least once or more), so that probably none of the water which was in the well at the date of the outbreak remained in it at the time of Dr. Jackson's visit.

The results of the whole inquiry appeared to warrant a conclusion that the water of this well (B) was contaminated

by the contents of the cesspool; that it was probable that a pre-existing case of typhoid fever was the specific form of infection, and the outbreak of illness among the persons who drank of the water of this well was the effect of the specific infection of the water.

In consequence of the result of this inquiry, the Board advised that the use of the water of this well should be permanently discontinued. The disuse of the other waters which were examined, including that of another well (C) near the works, west of the office, was also advised.

The town are about introducing a new water supply, which it is hoped may prove an efficient remedy and safeguard against future danger.

Malarial fever. — The town of Deerfield, in Franklin County, is situated upon the Deerfield River near its junction with the Connecticut, the principal village (Deerfield Centre) being about three miles from the mouth of the river. The principal street of the town runs nearly north and south between the Deerfield River and the two railroads. This street has an elevation of a few feet above the Deerfield River, the land sloping gradually westward toward the river, which flows through the town, generally in a northerly direction, being bordered by large tracts of low, meadow land, all of which is thoroughly saturated with water. There is also a smaller tract of wet land east of the principal street, and between it and the New Haven and Hartford Railroad. Running northerly along the west side of the road leading to Greenfield is a drain or open ditch, at a considerably higher level than the average level of the Deerfield River. It has been the custom of the town to clean this ditch at such intervals as were necessary to give a free course to the water. At the time when this locality was visited by the secretary of the Board, in 1888, the ditch had a dense growth of vegetation.

Upon this street of Deerfield and in its immediate neighborhood there have been, in the past three years (1886, 1887 and 1888), according to the estimate of the resident physician, two hundred cases of distinct malarial fever, occurring in about seventy houses, the number of persons

attacked in each house ranging from one to seven, with an average of nearly three in each house. The number of inhabited houses in this district is but one hundred and twenty-five; in more than one-half of which the occupants suffered more or less severely from malarial attacks.

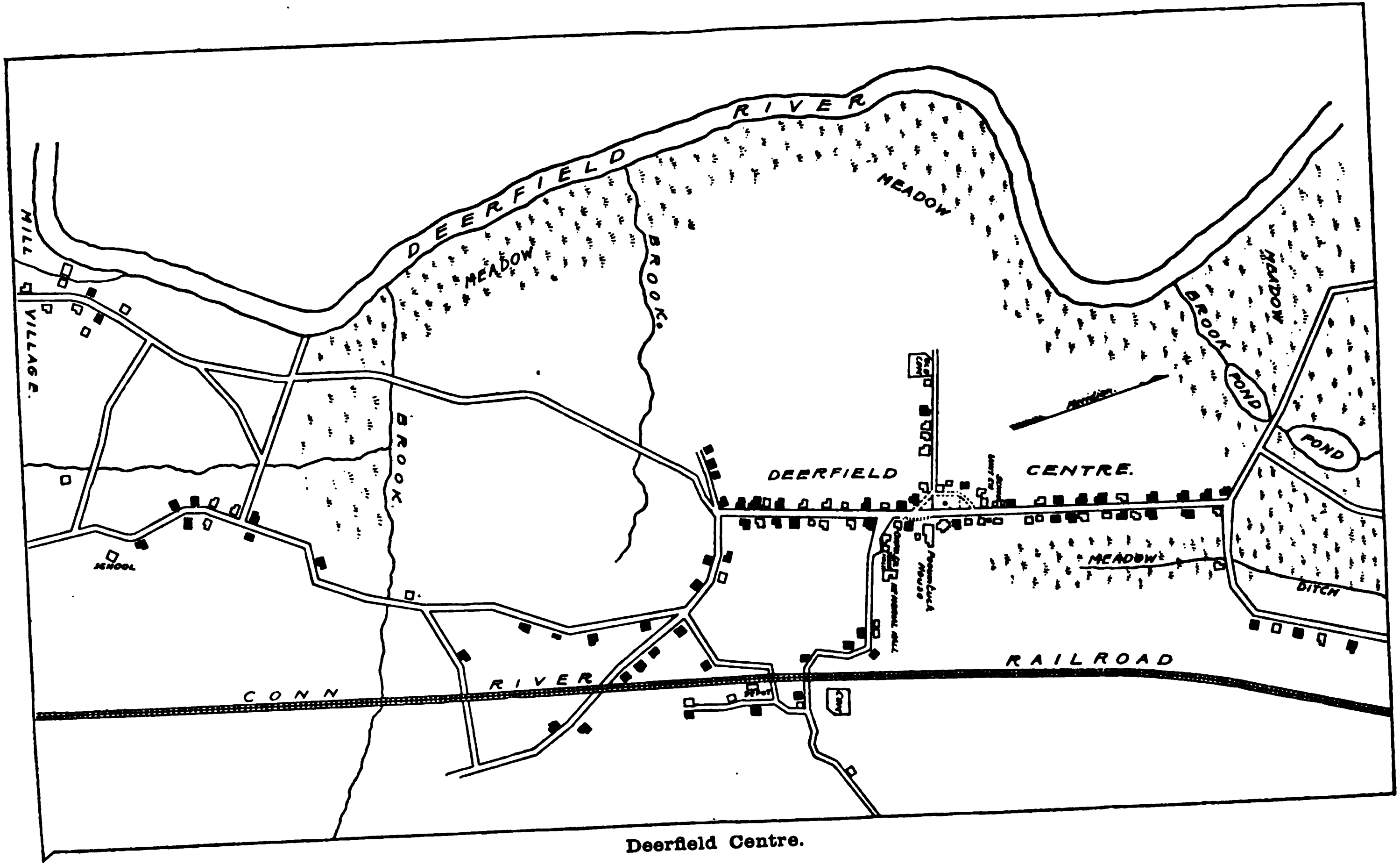
Dr. Newell, the resident physician at Deerfield, writes, in regard to the prevalence of malarial fever in that town: —

"I can learn of but two or three cases in this town previous to the summer of 1886, my first year in town. During the latter part of the summer of 1886, it prevailed to a considerable extent among those living near the low, marshy land at the south end of Deerfield Street; it was entirely confined to that locality at that time. In the next season (1887) it spread rapidly through the village; by far the larger part of the total number of cases occurred then. Early in March of this year (1888) it again made its appearance. The first case occurred in the week following the great storm of March 12, and in persons who had never previously suffered an attack. It continued very prevalent until about September 1, and since then there have been but a very few cases. Soon after the heavy rainfall began, the number of cases fell from several new cases each day to but two or three cases in all since September 1. The total number of cases during the past three years exceeds two hundred; and I count only those cases which were unmistakable, in which the paroxysm, with its regular order of chill, fever and sweating stages, was present. This number of cases occurred on a territory triangular in shape, a little more than two miles in length, and about one-half mile in width at its larger end. The total population in this district is about 450."

Measures have recently been taken to clean the ditch of its vegetation and improve the drainage of the village, so that the water will find a freer course to the river. The accompanying map of Deerfield village shows the location of the houses in that district of the town in which malarial attacks were most prevalent in 1886–88. The invaded houses are shaded on the plan.

In the other districts west of the Connecticut River which have been visited by outbreaks of malarial fever within the past ten years, its prevalence has been very much diminished as compared with the earlier years of the present decade.

The district which was the subject of a paper by Dr. Z. B.



Deerfield Centre.

Adams, in the report for 1885, has been visited by this disease in each successive year since that date. The neighboring towns of Natick and Wellesley have also been visited in the succeeding years, and also some of the smaller towns in the immediate neighborhood. In a recent paper, presented by Dr. Cook of Natick at the annual meeting of the Massachusetts Medical Society, the total number of cases which had been reported to him by physicians in those towns as having occurred in the months of its greatest prevalence (April to October inclusive), was 1,181; of which 1,010 were credited to Framingham, 157 to Natick and 14 to Wellesley. Of these, 103 occurred in 1885, 290 in 1886, 401 in 1887 and 387 in 1888.

Hydrophobia. — A few cases of rabies in dogs having been reported previous to the date of publishing this report, it is proper that some comment should be made with reference to this disease. No deaths have occurred from this disease in Massachusetts for a period of seven years, until 1889, and the total number of deaths from this cause for the whole period of registration (forty-six years), was but 72.

The years in which deaths have occurred, and the number in each since 1857, are as follows: —

Years.	Deaths.	Years.	Deaths.
1857,	1	1870,	2
1858,	2	1876,	4
1859,	3	1877,	14
1860,	2	1878,	15
1863,	1	1879,	5
1864,	1	1880,	3
1867,	1	1881,	3

The average number of deaths from this cause in each year of the whole period of forty-six years was less than two, and, when it is considered that in the same registration period there were more than 200,000 deaths in the State from consumption, 38,000 from scarlet fever, 27,000 from diphtheria and 46,000 from typhoid fever, the comparative importance of hydrophobia in its destructiveness may be

understood; and yet a single case occurring in any community often creates a general panic.

The whole number of deaths from this cause reported in the United States in the census year 1880, was 80. These were distributed among the States with considerable uniformity, and also throughout the year, the greater number occurring in August.

By the provisions of a statute enacted in 1877 (chap. 102, sect. 83, of the Public Statutes), the secretary of the State Board of Health is required to furnish a "description of the disease in dogs known as hydrophobia" to the clerks of cities and towns on application by them for the same.

For this purpose the secretary has during the past year published the following circular and forwarded a copy to the clerks of cities and towns throughout the State.

Hydrophobia.

[Description required by Chap. 102, Sect. 83, of the Public Statutes.]

The animals known to be primarily affected with hydrophobia are chiefly dogs. Cases have also occurred in other allied species of carnivorous animals (wolf, fox, raccoon, cat, etc.). (The entire number of deaths from this disease among human beings in Massachusetts for the past forty-six years has been but 72.) The disease may be communicated by inoculation to probably all warm-blooded animals; it prevails most in temperate climates, and pretty uniformly at different seasons (in the United States, of 2,407 cases, 671 occurred in spring, 583 in autumn, 580 in summer, 573 in winter). It is thought by the best authorities to affect both sexes in dogs alike, although there are more cases occurring in male dogs, as there are more male dogs in existence. There is no evidence that men can have hydrophobia except by direct inoculation from an infected animal; all men bitten by mad dogs do not necessarily have the disease, even when no treatment is adopted. No kind of dog, so far as known, is specially liable to hydrophobia, except in a general way those that live under unnatural conditions of climate, food, etc. Poodle dogs, pet dogs, and those living in heated houses, with little exercise, and fed with unsuitable food, etc., half-starved stray dogs, and unacclimated dogs, are more likely to have hydrophobia than others. All mad dogs do not necessarily bite other animals, if not interfered with; but it is evident that the more ferocious the nature of the dog, either naturally or by training, the greater are the chances

that he will bite people, and so communicate the disease. The symptoms of dogs are referable to three stages, in no one of which there is any dread of water (which is a symptom of the disease in man alone, and not always in him); indeed, a mad dog is more than commonly thirsty. Hydrophobia may be communicated to men by the saliva of dogs which have been for some hours dead.

In the **FIRST STAGE** there is a change in the habits of the dog; he becomes dull, gloomy and silent, seeks to isolate himself in out-of-the-way places, is very restless, lying down and getting up frequently, constantly changing his position and being in a continual state of agitation. The appetite is capricious, and only delicacies are eaten first, while, a little later, all manner of strange material, sticks, stones, straw, dung, etc., are greedily taken. The animal appears sullen and obeys his master's voice less readily than usual, although for a few moments he may seem more lively than common. Sexual excitement is usually an early symptom. There is seldom an increased disposition to bite at this stage, and there is no frothing at the mouth, but the saliva is capable of communicating the disease. Petted dogs are especially dangerous in this condition, because their bite, if trivial, is liable to be overlooked and not treated, and because they are allowed to lick the face and hands of their owners, and may inoculate any small spot where the skin is broken.

For from twelve hours to two or three days later, in the **SECOND STAGE**, the restlessness becomes more marked; the dog throws about the straw in his kennel, scratches and tumbles cushions, rugs, etc., is constantly in motion, and acts as if impelled by some fancies or hallucinations of sight and hearing. He starts as if attacking some object, darts forward, snaps at imaginary objects, and then is quiet for a moment. The saliva now becoming free and virulent, he froths at the mouth, his eyes are red and fierce-looking, the pupils dilated. He soon escapes all control, and wanders ferociously about as if impelled by some irresistible force, and attacks, without snarling or barking, any living thing, especially dogs, while there are occasions of paroxysms of fury or muscular spasms, in which there is great evident suffering, succeeded by lassitude and momentary insensibility. In these spasms the muscles of the throat are more or less affected, and the voice of the animal becomes dry and husky, somewhat resembling that of a child in the croup, while the thirst is inordinate. If the dog is kept in a dark, quiet place, these spasms usually do not appear.

In the **THIRD STAGE,** of paralysis, especially of the mouth and jaw, there is inability to bite, and the great majority

of dogs who live so long die of exhaustion, with blindness, inability to swallow, emaciation, etc. The voice is nearly or quite absent throughout this stage. There is also a form of hydrophobia called "dumb madness," in which the violent or second stage is aborted; the early paralysis of the muscles of the throat causes the lower jaw to drop and the mouth to remain open, with inability to make a loud noise. Less than ordinary sensibility to pain, and a disposition to attack other dogs, and an unusual courage are present in this as in other forms of the disease.

Treatment of the Living Dog.

All the symptoms above detailed may not appear in any one dog, for no two cases will be strictly and exactly alike; but it is believed that the detection of hydrophobia may be generally made easy by careful observation and attention to the foregoing points.

If a dog has the symptoms detailed in the foregoing description, *well-pronounced*, he should be killed forthwith, as a measure of prevention. If, on the other hand, a dog is sick, especially if he is sullen, and has a capricious appetite, and is unusually inclined to attack other dogs, he should be confined and kept under close observation, and at once killed if unmistakable signs of hydrophobia appear.

If a dog, which has no unusual signs of disease, bites any one, he should not be killed, but should be kept under observation. If he manifests no symptoms of hydrophobia within a week, the dog may be released, and the person bitten may rest assured that no infection from the bite is possible.

If wounds by rabid animals are thoroughly washed and cauterized at once with a white-hot iron, or with nitrate of silver, it is shown by statistics that an attack of the disease may be avoided in a vast majority of cases. Internal medicines are of no use as preventives.

SAML. W. ABBOTT, M.D.,
Secretary of the State Board of Health.

OFFICE OF THE STATE BOARD OF HEALTH,
13 BEACON ST., BOSTON, May, 1888.

Hydrophobia is an infectious, communicable and preventable disease.

It is infectious, since it is one of the great group of specific diseases which depend for their mode of propagation upon some active principle, some *contagium vivum* which is developed within the individual, and through the medium of

which the disease is transmitted either directly or indirectly to other individuals.

It is communicable, since it may be communicated directly from one dog to other dogs, and also to other animals, including man, such transmission being effected by the virus which the animal, by its bite, succeeds in introducing into the body of his victim.

It is preventable, in the first place, either by complete isolation or destruction of the sick animal, and, secondly, if infection has taken place, prevention is possible by immediate suction of the wound, or destruction of the surrounding tissues, either by some very active caustic like nitric acid, or by the actual cautery. Should this procedure be neglected until its practice would be without avail, inoculation with attenuated virus, after the plan of Pasteur, may be practised. Such a procedure, however, should only be entrusted to the care of an expert.

Trichinæ in Swine.

In several of the earlier reports of the Board evidence has been presented relative to the prevalence of trichinosis in Massachusetts, both in the human being and also in the hog.* Reported cases of infection of human beings in this State are quite rare. The entire number which has come to the knowledge of the State Board of Health in a period of twenty years has been but twenty-three, of which one only proved fatal. When compared with recent German outbreaks of trichinosis, these figures appear insignificant for a State of two million inhabitants. In one small neighborhood, comprising three villages, having a population of only 1,400, in Saxony, there were 403 cases in 1883 with 66 deaths from this cause.

On the other hand, infection of the hog appears to be of common occurrence in the pork slaughtered in Massachusetts, and especially in that of hogs which have been fed

* Second report of State Board of Health, 1871, pp. 46-50. (Dr. Derby).
Sixth report of State Board of Health, 1875, pp. 151-157. (Dr. Folsom.)
First report of State Board of Health, Lunacy and Charity (Supplement), 1879, pp. 25-54. (Dr. F. S. Billings.)
Fifth report of State Board of Health, Lunacy and Charity (Supplement), 1883, 179-189.

upon city offal or swill. Dr. Billings examined 8,769 hogs from various sources with the result of finding 345 or 3.9 per cent. of them trichinous. These examinations by Dr. Billings were of hogs which were slaughtered in Massachusetts, "but came from different parts of the country, mostly from the West;" it is not, therefore, to be inferred that all American hogs are infected to the excessive degree determined by Professor Mark's examinations.

In a subsequent examination by Professor Mark of 500 hogs, he found but 10, or 2 per cent., trichinous. In his present report the examination was limited to such hogs as were raised within a few miles of Boston and were fed mainly upon city offal. The whole number of these examined was 3,064, of which number 394, or 12.86 per cent., were found to be trichinous. In addition to these there were also 234 from public institutions in which the percentage of trichinous hogs was even greater than that of the hogs raised by private individuals, namely, 17.95 per cent.; the average of the whole number being 13.22 per cent. or 1 in 7.5.

In commenting upon the causes contributing to this excessive prevalence of infection, Professor Mark says, "I believe that probably all, or at least nearly all the cases reported here, imply the consumption of uncooked trichinous meat on the part of the infected hog."

Valuable suggestions are presented by Professor Mark with reference to further inquiries which should be conducted for the purpose of settling some of the questions relative to the sources of infection which are still in doubt.

It is almost needless to add that the danger to human beings may be avoided by thorough cooking of all pork intended for food.

The Sale and Use of Opium in Massachusetts.

The Legislature of 1888 enacted the following resolve relative to the sale and use of opium: —

Resolved, That the State Board of Health be requested to make an investigation concerning the sale and use of opium in various forms and preparations, with a view to ascertaining the extent of the evils arising therefrom; whether such use and evils are increasing, and, if

so, the manner and cause therefor, and what remedies for such evils may be proposed; and to report the result of such investigation to the General Court.

This inquiry was entrusted to Dr. B. H. Hartwell of Ayer, and the results of his investigations appear in the present report. There has been a popular belief, fostered very largely by sensational articles in the daily newspapers, that the opium habit was very prevalent in the community, and that there had been a rapid increase in its prevalence within a few years.

Circulars were addressed to a large number of persons whose occupation or profession would entitle them to be considered as experts upon the special subject of this inquiry. The replies to these circulars were received from about six hundred druggists and two hundred and sixty physicians. The circulars to physicians were sent mainly to those whose age and experience in practice would entitle them to special weight in deciding upon this question. In addition to these, circulars were also addressed to superintendents of insane hospitals and other public institutions where the class of inmates would furnish special information upon the subject.

A large majority of the replies to these circulars appear to indicate the belief, both on the part of physicians and that of druggists, that there has been no increase in the opium habit in Massachusetts.

Another indication of the same character may be found in the statistics of the importation of opium, since it is an article almost exclusively of foreign production. The actual amount imported should give a clew to its consumption. For the whole United States for the nineteen years (1870–1888), there was an actual decrease from 62.5 grains per capita in the ten years (1870–1879), to 54.3 grains per capita in the nine years (1880–1888), an actual decrease of 8.2 grains per capita, estimating the present population at 60,000,000.

A small allowance must undoubtedly be made for that which is smuggled, but there is no evidence that this constitutes a larger percentage of the whole amount, or that it is greater now than it was twenty years since.

Considerable weight should be attached to the replies from the superintendents of seven insane asylums, five of whom reply that in their opinion the use of opium is not increasing.

While Dr. Hartwell's report, therefore, gives valuable testimony relative to this subject, he concludes that "the use of opium is not increasing in Massachusetts." For the restriction of such evils as already exist, he recommends the enactment of a law providing that such preparations as are offered for sale containing opium should distinctly state the fact that opium is an ingredient, together with the amount contained therein.

Health of Cities and Towns.

Abstracts of reports of the local boards of health of cities and towns, which have been received at the office of the State Board, are presented in this report. Among the subjects presented in these reports, those which appear most prominent are the reports of contagious diseases, which are quite generally made in the cities and the larger towns.

The subjects of water-supply and the need of better sewerage systems also occupy an important place. Great progress has been made in this State within the past twenty years in this direction, and the proportion of the population supplied with good and efficient water supplies has very largely increased, while the cities and towns which have adopted plans of sewerage have also largely increased in number.

Registration of Vital Statistics.

The registration of the births, marriages and deaths occurring in Massachusetts has been conducted continuously for a period of more than forty-seven years by the department of State. It forms a valuable history of the movements of the population during this period as affected by these three classes of records. A thorough analysis of these returns reveals many significant facts pertaining to the material as well as the sanitary progress of the State. The editing of the report was entrusted to the State Board of Health, as in the previous year.

In addition to the returns of births, marriages and deaths comprised in the report, two successive acts of the General Court have also required the collection and publication of the facts relative to divorces, and also the returns of medical examiners, which include the statistics relative to death by violence. The following is a brief summary of the facts presented in the forty-sixth registration report for the year 1887, recently published: —

Population.

The estimate of population upon which the different ratios of births, marriages and deaths have been made is based upon the supposition that the same rate of increase continued from 1885 to 1887 as had prevailed from 1875 to 1885, which would indicate a population of 2,010,388 for 1887.

Births.

The number of births recorded in 1887 was 53,174, and assuming the population to have been 2,010,388 the birth rate was 26.4 per 1,000 of the living population. This number was 2,386 more than that of 1886 and also greater than that of any previous year.

The number of still-births recorded (not included in the figures given above) was 1,794.

The ratio of male to female births was 105.2 as compared with 105.7 for the period of thirty-four years (1863–1886).

Illegitimacy. — There were 1,158 illegitimate births registered during the year, which was 21.8 per 1,000 of the whole number of births. This was a greater ratio than that of any previous year.

Marriages.

The number of marriages recorded in 1887 was 19,533, which represented a marriage rate (persons married) of 19.4 per 1,000 of the living population. This was a higher rate than that of any previous year since 1873.

The average age of persons married has been remarkably uniform for many years. That of men for 1887 was 29 years. That of women for the same year was 25.5. In each instance these figures were but slightly higher than the average of twenty years.

Deaths.

The number of deaths registered in 1887 was 40,763, which was 3,519 more than that of 1886, and also greater than that of any previous year. This would indicate a death rate of 20.3 per 1,000

of the living population. This rate was greater than that of 1886, and the increase of mortality was found to be considerably greater in the densely inhabited cities and towns than that of the rural districts. The increase in all of the departments of record (births, marriages and deaths), which was greater than the average increase of the previous ten years, would appear to indicate a greater increase of population than that which is apparent by the usual method of calculation.

The excess of the birth rate over the death rate (which represents the natural increase of the population, leaving out of account the effect of migration) was 6.1 per 1,000, a ratio which was greater than that of any previous year, except 1886, since 1877.

For the sake of convenience in estimating the density of population the counties of the State are divided into two groups.

One of these groups consists of six counties (Suffolk, Middlesex, Essex, Norfolk, Bristol and Hampden) and contains twenty-one of the twenty-five cities, and all of the large cities except Worcester, and may properly be called the urban or manufacturing group. The remaining counties comprise the other group and may be called the rural or agricultural group.

In the former group, with a density of 442 to each square mile, as estimated upon the census of 1885, the mortality rate was 21.8 per 1,000 of the living population, and in the latter group, with a density of 102.0 to each square mile, the mortality rate was 18.8 per 1,000.

There was, therefore, a difference of three per 1,000 in favor of the rural counties, as compared with a difference of two per 1,000 in 1886.

These death rates are undoubtedly higher than the actual death rates, since the population has probably maintained a rate of increase as great as that of the years immediately preceding, and the ratio of mortality in one group, as compared with that in the other, may also differ considerably from the estimate, in consequence of a difference in their rapidity of growth.

Infant Mortality. — The number of deaths of infants under one year of age (8,514) was greater than that of any previous year since the beginning of registration. The ratio of deaths under one (20.89 per cent.) to the total deaths was less than that of the previous year, and was also slightly less than the average of the past sixteen years.

As compared with the number of births, the ratio was 16.01 per cent., which was greater than that of any year since 1882, and was also .2 of one per cent. less than the average of the past sixteen years.

Causes of Death. — The returns of deaths from unknown causes show an almost constant improvement since 1868, the percentage of failure to return the causes of death having been steadily diminished since that date with a marked degree of uniformity. This improvement is largely due to a greater care on the part of registration officers, and also a better discrimination as to the causes of death on the part of the physicians who are responsible for the certificates of death.

From the general class of diseases usually called zymotic, among which may be found most of the diseases which may be considered as indicative of sanitary conditions, there were 7,948 deaths, or 19.5 per cent. of the total number, a percentage which was slightly greater than that of the previous year, but considerably less than the average of the previous ten years.

The deaths from constitutional diseases were 9,104, and comprised 22.3 of the total number, which was less than that of any previous year for ten years, and consequently less than the average of that period.

There was an increase in the deaths from local diseases as well as in their percentage of the total number, the deaths from such causes being 17,203 and their percentage to the total number 42.2, the average for the previous ten years being 39.6.

There were during the year only three deaths from small-pox, the details of which have already been given in the report of the Board for 1887. Statistics are given in the report embracing a period of twenty-five years and including the serious epidemic of 1872, which show the effect of vaccination in modifying the fatality of the disease and especially in transferring the mortality from infancy to later periods in life.

The number of deaths from measles was 455 and was greater than that of any previous year since the beginning of registration.

Of these 455 deaths from measles, 344, or more than 75 per cent., occurred in Suffolk and Middlesex counties, 170 in the former and 174 in the latter.

No deaths from this cause were registered in Barnstable, Berkshire, Dukes and Nantucket counties.

The mortality rate from this disease, as compared with the population at each age-period, was 10.13 per 10,000 annually for children under 5 years of age, for the twenty-five years 1863–1887, the ratio diminishing rapidly until the age-period 50–60, and then increasing considerably to the older ages.

From scarlet-fever there were 594 deaths. This number was greater than that of the previous year, but the mortality rate from this cause, both as compared with the total mortality and also with

the population, was but half as large as the average mortality rate of the thirty years (1858–1887).

From diphtheria and croup there were 1,628 deaths, this number being slightly greater than that of 1886, while the percentage to the total mortality was less.

The deaths from typhoid fever were 922, which was 122 more than those of 1886, while the ratios to the total mortality and to the living population have presented slight differences only for the past five years. The relative mortality from typhoid fever at different ages of life shows a comparatively uniform incidence for the youngest ages up to 60 years, with a considerable increase between the ages of 15 and 30, and a more decided increase from 60 to the close of life, for the 25 years 1863–1887. For the single year 1887 there is an increase with considerable uniformity from the earliest period, up to the age-period 20–30 years, while for the remainder of life the ratio presents a similar average rate to that of the period 10–15 years, the ratios for each period being generally less than those of the group of years 1863–1887.

As compared with the living population, the death rates from this disease per 10,000 in census years show the following figures: For 1865, 13.4; 1870, 9.1; 1875, 6.4; 1880, 4.9; 1885, 3.9.

The deaths from dysentery were 266, which was a greater number than that of 1886, but considerably less than the average of the previous 10 years. The greatest relative mortality, both for the whole period of 25 years (1863-1887), and for the single year 1887, was at the extremes of infancy and old age. There was also in both instances a decrease in the relative mortality with considerable uniformity from the youngest age-period to the period 15–20 years, and then a progressive increase up to old age.

The number of deaths from cholera infantum was 2,131, or 10.6 per 10,000 of the population. This ratio was slightly greater than the average of the 10 years (1878–1887), but considerably less than that of the 10 years (1868–1877.)

The deaths from consumption were 5,871, and the ratio to the total mortality 14.4 per cent., which was the least of any year yet recorded. The death rate to the estimated living population was 29.2 per 10,000, as compared with 32.8 for the 25 years ending with 1887. The mortality rates from this disease at each period of life, as estimated from a comparison with the number of persons living at such ages, show that this destructive disease was most fatal at the age 70 to 80 for the period 1863–87, the age 20 to 30 coming next in order; while for the year 1887 it fell most severely upon the age-period 20–30, the following period, 30–40, coming next in the order of fatality. The mortality at each period of life was

less in 1887 than it was for the average of the whole period at the same ages, the greatest differences appearing at the older age-periods from 50 years to old age.

While the mortality from consumption presents a tolerably uniform ratio, that from pneumonia is more variable from year to year. The deaths from pneumonia for 1887 were 3,348, which was greater than the number in 1886 and less than that of 1885. The mortality rates at different periods of life show a high rate for infancy, rapidly decreasing to the age 10–15, and then increasing with less rapidity to old age. The comparative mortality at the different age-periods maintained a very uniform variation for the 25-year period and for the single year 1887, the ratios in the latter case being higher for each period of life than those of the series of years (1863–1887). In both cases the mortality of old age from this disease is shown to be excessive, a point which is not made clear in the reports of former years.

There were 232 deaths from whooping-cough, more than half of which occurred in Suffolk County.

Medical Examiners' Returns.

These include all of the deaths from violent, sudden and suspicious causes, which are referred to the medical examiners for their investigation.

The whole number thus examined in 1887 was 1,556, of which 52 were from homicide, 173 from suicide, 748 from accident or negligence, and 583 from various natural or unknown causes, usually of a sudden or suspicious character.

The chief point of interest having any bearing upon the question of public health in this connection, is the remarkable increase in the number of deaths from arsenic. The greater number of these were suicides. These deaths have taken place as a result of the free use of this poison, in recent years, for the destruction of various insects and other pests, and the consequent greater facility of obtaining it. The law regulating the sale of poisons, enacted in 1888, was intended to restrict the sale of such substances, and to prevent their use for the destruction of human life, either by homicide, by suicide, or by accident.

The table of mortality from this cause published in the last registration report is herewith quoted in full: —

Deaths from Arsenical Poisoning.

YEARS.	Homicidal.	Suicidal.	Accidental.	Total.
1877 (six months),	–	2	–	2
1878,	–	2	1	3
1879,	–	6	–	6
1880,	2	3	2	7
1881,	–	3	–	3
1882,	–	2	–	2
1883,	–	3	1	4
1884,	–	16	–	16
1885,	–	12	1	13
1886,	6*	14	2	22
1887,	1	35	–	36
	9	98	7	114

* These cases, nearly all of which are known as the Robinson cases, are recorded in the year in which the investigation was made, and not in the years in which the deaths occurred. In some instances the death occurred three or four years earlier.

By this table it appears that there has been an increase from 2 cases in the half year 1877 and 3 in 1878, to 22 in 1886 and 36 in 1887. If the five and a half years, 1877–1882, be compared with the five years 1883–1887, the average annual number in the latter period is found to be more than four times that of the former. This ratio must be somewhat reduced by the fact that the returns in the earlier period were voluntary, and comprised about two-thirds of the actual cases. With this reduction the increase would still be nearly in the ratio of 3 to 1.

As compared with the living population, the deaths from arsenic were 1.8 per 100,000 in 1887; and the deaths from arsenic in that year were more than all the deaths from small-pox for the previous five years and more than the deaths from hydrophobia for 10 years.

Purity of Ice Supplies.

By the provisions of a Resolve of the Legislature of 1888, the State Board of Health was directed to "make a special investigation with reference to the pollution of ponds, lakes, streams, or other bodies of water used as ice supplies in this State, especially with reference to the effect of such pollution upon the heathfulness of such ice for domestic use, and to refer the results of their inquiry to the next General Court."

Acting under this resolve, much information was gathered in regard to the sources of ice supply throughout the State, and an

and distribution of micro-organisms in the air of inhabited apartments, the wards of the Boston City Hospital being selected for the purpose. The determination of the specific forms of such organisms was not sought for, their number and comparative distribution in different wards and at different times of the day, under varying conditions, being the chief object of the inquiry.

Parallel examinations of the amount of carbonic acid present in the same wards was also made, and certain observations were also made upon the effect of sulphur fumigation upon the number of micro-organisms present in a closed vault in which such method of disinfection was practised.

The method of collecting the samples of air is detailed by Mr. Tucker.

The conclusions derived from this inquiry are, that, while good ventilation is essential to ensure the freedom of the air of occupied apartments from the presence of an excess of carbonic acid, this measure should also be coupled with the practice of systematic cleanliness, to prevent the development and multiplication of micro-organisms in the air. The bacteria which exist to a greater or less extent in impure air, are heavier than the air, and after they have once been introduced into the air of an apartment by sweeping, by the making of beds, or other operations, they settle to the floor with the dust, where they may be removed by mopping with damp cloths.

Mr. Tucker, therefore, distinctly states that "the wards which show the best average results in the absence of carbonic acid are also the freest from micro-organisms."

The observations upon the effect of sulphur disinfection show that the mode of its application at the hospital at the time of the experiment was not successful in removing the bacteria from clothing by means of the fumes of burning sulphur.

Summary of Mortality Reports.

The summary presented in this report embraces the facts derived from the weekly reports which are received at the office of the Board, after the close of each week, from the authorities of such cities and towns as are accustomed to require prompt returns from all persons who are required

by law to sign certificates of death. This applies to the large cities and towns, and to some of the small towns, but not to all, since there are many localities in which the law is not enforced, and consequently the actual number of deaths is not recorded until long after their occurrence, and frequently not until the close of the year. These places are chiefly in the sparsely settled or rural portions of the State, in which the death rate is usually less than that of the cities, and hence the mortality shown by this report, embracing as it does the data of a majority of the population, is greater than the average mortality of the State.

In the present report an additional feature has been introduced in the form of a summary of the reports of the past six years, showing the prevalence of each of several of the principal infectious diseases for each successive week in the six years, by which it appears that the mortality from the more destructive of these diseases for 1888 presented very nearly the same variations in different seasons of the year as those of the entire period of six years.

Noxious and Offensive Trades.

No cases have been directly referred to the Board during the past year under the provisions of this act. In a few instances cities and towns have taken action in cases which have occurred within their own limits.

The statute (chap. 80, sect. 84, Public Statutes) gives to the local board of health more summary authority in such cases than it does to the State Board by section ninety-three of the same chapter, since the local board of health can at any time, and without the formality of a hearing, forbid the exercise of any such trade or employment within the limits of the city or town in which it is located, while the State Board can only order the person carrying on such trade or occupation to desist and cease from carrying it on, after a hearing has been granted at an appointed time and place.

Local Boards of Health.

The necessity of a better organization of local boards of health in towns becomes every year more apparent as the density of population increases. The density of any popu-

lation or community is measured by the distance which separates the individual units which compose the population from each other, or by the number of persons who occupy a given area.

The population of Massachusetts in the year of the State Census of 1885, was 233 to each square mile, which indicated a greater density than that of any other State except Rhode Island.

In the counties which are the most densely populated, and which contain the principal cities and large towns of the State (Suffolk, Essex, Middlesex, Bristol, Norfolk and Hampden, containing twenty-one out of the twenty-five cities) there were 442 persons to each square mile, or nearly double the average density of the State, and, when the large amount of unoccupied land is considered, it is plain that the density of the villages and inhabited portions of the towns must be very much greater than this average. It is this element of proximity to one another that renders the need of enforcement of sanitary rules and regulations every year more and more apparent. In the sparsely settled farming district, where habitations are from fifty to a hundred rods or more apart, the question of public health in nearly all of its many-sided phases is of less consequence than it is in a thickly settled community where people can scarcely move without jostling each other, and where the average number per square acre is as great as the number per square mile in the rural districts.

Ten persons dwelling upon or occupying an acre of ground are far more likely to communicate infectious disease to each other; the liability to cause nuisances is greater, the probability of injuring each other's water supplies is greater, and other questions pertaining to ventilation, school-hygiene and even that of food adulteration (as shown in the report of the Board for 1883) become more prominent than could possibly happen among the same ten persons when distributed over a square mile of territory.

Especially is this the case in regard to infant mortality, which is far more prevalent among densely populated communities than it is in the more sparsely settled towns.

It is the province of public hygiene to correct these evils,

accruing in consequence of the increasing density of population, to apply the proper remedies for the prevention of such diseases as are justly termed preventable, and to protect the community from every possible source of injury to health.

For the execution of the laws which have been enacted to provide for the important questions relating to the protection of the health of the people, it is essential that a proper local organization should exist in every town, or at least in every town having densely populated villages or settlements of people. Such an organization should be composed of persons having special qualifications for the performance of sanitary duties. School committees, trustees of public libraries and road commissioners are chosen with special reference to their fitness for the work which they are expected to perform or to superintend; but the law relating to the very important duties of protecting the health of the community is such that, in the majority of the towns, these sanitary questions are committed to the board of selectmen, a body of men whose duties are of an entirely different character. The qualifications required of the selectmen are usually of a general character, and are such as relate to the management of the economic, financial and general business interests of the town. The result of imposing this additional burden of a special nature upon a board already chosen for general purposes is such that, when an outbreak of infectious diseases occurs in the town, or some other important sanitary question arises, it not infrequently happens that the community suffers serious harm. Infectious diseases, for which well-known means of prevention can be applied, are suffered to spread; households are invaded by disease, and deaths occur which might otherwise have been prevented had an efficient and well-qualified local board of health been at hand to take the proper measures for protecting the community.

No year has elapsed for a long period in which instances have not occurred which prove the imperative need of a radical change in the present law. The following are selected out of a large number which have occurred, which may be taken as illustrations of the need of such change in the statute relating to the election of local boards of health: —

——— 1888.

DEAR SIR: — Scarlet-fever has prevailed in the neighboring town of ——— during the past six months. There have been several deaths therefrom. Public funerals are held and no quarantine is required. The selectmen of the town constitute the local board of health. If you would look into this matter it might be not only beneficial to the inhabitants of that town, but also to the dwellers in the adjoining villages, where they are likely to bring the disease, and whose inhabitants are considerably exercised at the absence of sanitary precautions. . . .

Very respectfully yours,

——— ———

From another locality came the following: —

Our selectmen seem to be indifferent about the spread of scarlet-fever, indeed one of them has two children sick with it. He says it isn't anything but a distemper, and allows his children to run at large, and people go in and out of his house just the same. Another case occurred last Monday in another family and my nearest neighbor has been in to see the child. . . . The selectman only laughs and thinks it of no consequence.

And this man was *ex officio* a member of the local board of health.

One of our citizens has left a dead cow in an open lot. Is this good for the health of the community? I have spoken to our board of health (that is, the selectmen) and they talk favorably, but do nothing else.

The town of ——— is blessed with a board of health in name only (the selectmen). We have had seven cases of scarlet-fever within a short time, and they have all been properly reported by the attending physicians. The board has taken no steps whatever to protect the community. . . . I have personally interviewed the chairman of the board, and receiving no satisfactory reason for their inaction entered a formal complaint. I am informed that no action was taken about it. Is there no way we can get protection? Any advice or information which you can give will be fully appreciated; and I am only one of many who are deeply interested in our own and our children's protection.

———, August 30.

To the State Board of Health, Boston, Mass.:

I wish to call your attention to the fact that ——— ———, proprietor of the ——— House at ——— Beach, has maintained a nuisance for years in the shape of a hog-yard, the smell of which is most disgusting. The selectmen and police do nothing, although they have been urged many times to act in the matter. If you will attend to this duty at once you will receive the thanks of thousands of suffering people.

Truly yours,

——— ———

These are only a few of the communications which are often received by the State Board, which indicate the defects of the present law relative to the organization of local boards of health.

Water Supply Returns.

By the provisions of chapter 80 of the Public Statutes, sections 103, 104 and 105, water boards and companies were required to make triennial returns of certain specified facts to the State Board of Health, which the Board is required to publish. Two reports have been made by the Board in which these facts were compiled in the manner required by the statutes.

Blanks were issued as usual for the returns required by the Statutes of 1879, and a portion of them only have been returned to the office of the Board as required. From these the data relative to the cost of construction and existing debts, together with the principal items of the water-rates, have been selected for publication. Information relative to other subjects embraced in the replies to these inquiries has been collected under the provisions of the "Act to protect the purity of inland waters," and will be presented with much greater fulness and detail in a supplementary volume, which will shortly follow this report.

Recommendations.

The Board renews its recommendations relative to the enactment of a more efficient statute providing for local boards of health in towns.

The increasing loss of life from the different preparations of arsenic renders necessary more stringent legislation to protect human life and health from this poison.

During the year, in addition to the work of the Board detailed in the foregoing pages, and also in the special reports and papers which follow, the following matters deserve mention in this report: —

Nineteen meetings of the Board have been held during the year, and frequent meetings of the standing committees of the Board.

The Board has visited such places during the year as required the attendance of the full Board. Very frequent visits have also been made by the officers of the Board for the purpose of making such investigations as are required by the statutes.

Hearings by the full Board were also held during the year upon the following questions: —

The Sewerage and Sewage Disposal of Brockton, . .	Oct. 31, 1887
The Sewerage and Sewage Disposal of Waltham, . .	Nov. 22, 1887
The Sewerage and Sewage Disposal of Clinton, . .	Nov. 22, 1887
The Sewerage and Sewage Disposal of Pittsfield, . .	April 20, 1888
The Sewerage and Sewage Disposal of Framingham, .	April 24, 1888

Expenditures of the Board.

The following is a statement of the expenditures of the Board for the year ending Oct. 1, 1888, under the provisions of the different acts under which the Board is at present conducting its work.

The statement of expenses under the provisions of chapter 95 of the Resolves of 1887, requiring the Board to report upon the Metropolitan drainage system, includes the entire expenses under that resolve.

General Expenses.

For the Year Ending Oct. 1, 1888.

Appropriation,		$9,300 00
Salaries,	$4,033 35	
Printing,	880 57	
Stationery,	193 84	
Postage,	204 00	
Messenger,	241 00	
Special investigations,	997 55	
Chemical and other examinations,	57 00	
Travelling expenses,	650 19	
Books, maps and binding,	179 52	
Express and telegrams,	32 92	
Incidentals,	86 31	
Telephone,	81 90	
		$7,638 15

FOOD AND DRUG INSPECTION.

Appropriation,		$10,000 00
Salaries,	$7,036 43	
Legal services,	235 20	
Travelling expenses and purchase of samples,	1,387 62	
Packing-boxes, bottles, seals and other incidentals,	256 15	
		$8,915 40

EXPENSES UNDER THE PROVISIONS OF CHAPTER 274 OF THE ACTS OF 1886, AND CHAPTER 375 OF THE ACTS OF 1888, FOR THE YEAR ENDING OCT. 1, 1888.

Appropriation of 1887,		$30,000 00
Appropriation of 1888,		25,000 00
Salaries,	$16,763 01	
Travelling expenses and incidentals of engineers and other experts,	1,777 54	
Rent of Massachusetts Institute of Technology,	1,750 00	
Rent of 161 Tremont Street,	393 62	
Experiment station at Lawrence, labor and material,	7,792 32	
Stationery and printing,	411 24	
Boxes, bottles and other supplies,	959 37	
Maps, plans and books,	37 45	
Postage, express and telegrams,	214 76	
Incidentals,	351 61	
		$30,450 92

EXPENDITURES UNDER CHAPTER 95, RESOLVES OF 1887.

Salaries of engineers, assistants and workmen,	$21,570 74	
Travelling expenses,	1,059 73	
Stationery,	194 82	
Maps and plans,	253 71	
Furniture and repairs,	108 61	
Other supplies,	1,158 11	
Essex Company, materials, tools, etc., furnished,	218 47	
Chemical examinations,	20 00	
Rent of office (at Boston and Maine depot),	165 32	
Incidentals,	100 30	
Damages,	80 00	
		$24,929 81

HENRY P. WALCOTT,
JULIUS H. APPLETON,
THORNTON K. LOTHROP,
ELIJAH U. JONES,
THEODORE C. BATES,
HIRAM F. MILLS,
FRANK W. DRAPER,

State Board of Health.

WATER SUPPLY AND SEWERAGE.

I.

By virtue of the authority conferred upon the State Board of Health by the provisions of section 3 of chapter 374 of the Acts of 1886, afterwards superseded by section 3 of chapter 375 of the Acts of 1888, wherein the Board is required "to consult with and advise the authorities of cities, towns, corporations, firms or individuals," with reference to the introduction of water supplies and systems of sewerage, twenty-two applications have been received, of which eight related to water supplies and fourteen to sewerage and sewage disposal. The applications relative to water supply were from the following cities, towns and corporations: Maynard, Mansfield, Athol, Winchendon, Millbury, Fairhaven Water Company, Revere Water Company and Brockton.

Those which related to sewerage and sewage disposal were from Brockton, Ware, Haverhill, Winthrop, Pittsfield, Framingham, Westfield, Quincy, Northampton, Lenox, Foxborough, Charlemont, Newburyport and the Howland Mills Corporation of New Bedford.

Water Supply.

Maynard. Reference was made in the report of 1887 to the application of the town of Maynard for the advice of the Board as to the propriety of taking White's Pond, in the towns of Hudson and Stow, as a water supply.

From such examinations as had then been made by the engineer of the Board, conclusions which would warrant a definite reply had not been reached by the Board at the date of the last report. Subsequently, the town having had the necessary examinations made as recommended by the Board, the following reply was transmitted to them: —

White Pond, in the towns of Hudson and Stow, is a desirable source of supply for your town, on account of the very good quality of its water, as indicated by chemical analysis and an inspection of the locality; and because of its large storage capacity, the pond containing, when full, an available supply for the town for two years or more.

While the supply from the pond alone may prove sufficient for the wants of the town for many years, yet there is so much doubt

upon this point, that in designing the works the prospect of a supplementary supply should be kept in view to be provided for.

It is feasible to obtain a supplementary supply from the ground along and near the pipe line from White Pond to the proposed pumping station.

The experience in this State and elsewhere indicates that water taken from the ground should be stored in a reservoir from which all light is excluded, and this feature should be considered in designing the reservoir.

ATHOL. In the last report of the Board reference was made to the application of the town of Athol relative to the proposal to take Phillipston Pond as a water supply. The question was still under advisement at the close of last year. The Board, having considered the matter, gave the following reply: —

The water of Phillipston Pond is of good quality, and the quantity may be sufficient to supply the town of Athol for many years, but from the examination made by the engineer of the Board of Health it appears probable that good water in sufficient quantity may be obtained from sources nearer the village at less expense than to bring it from Phillipston Pond, with the further advantage of not interfering with the industries depending upon that water; and the Board recommends that the town have this subject investigated by a competent engineer before deciding to adopt the plan which they have proposed.

MANSFIELD. The Water Commissioners of the town of Mansfield applied for advice relative to a proposed ground water supply from the neighborhood of Cate's Springs in Mansfield, and the proposed source was approved by the Board.

WINCHENDON. The Selectmen of the town of Winchendon applied to the Board for its advice with reference to the Upper Naukeag Pond in the town of Ashburnham as a source of water supply. The following reply was forwarded to the authorities of that town: —

The Upper Naukeag Pond will evidently supply a sufficient quantity of water for Winchendon and Ashburnham for a long future.

Its surroundings appear unusually favorable for insuring a very good quality of water, and chemical examinations show an unusually small amount of impurity; but a peculiar and disagreeable odor has been found with every sample tested, which grows more disagreeable the longer it is kept. A visit to the pond in June, and examination of samples from many parts of the pond, show the odor to be in all parts of it. The cause of this odor has not been determined, but it has existed during the past four months, and is so marked that the Board does not, at present, recommend the adoption of this pond as the source of supply; but does recommend that the town employ a competent engineer, skilled in this kind of work, to make the necessary investigations to determine if an abundant and unobjectionable supply cannot be obtained from underground sources nearer the town.

Such information as the engineer of the Board may have acquired will be at the service of the town in making their investigation.

MILLBURY. The Selectmen of Millbury requested the advice of the Board relative to a proposed water supply, at the same time indicating certain sources of supply as having been investigated by their engineer. From these sources, springs adjoining the Millbury branch of the Boston and Albany Railroad were recommended by the engineer employed by the town as the best and most available source of supply. The Board, after considering the question, transmitted the following reply: —

After careful examination of the different sources of water supply for the town of Millbury, excepting that of the Worcester water works, which has been mentioned, but is understood to be unavailable, the State Board of Health finds that the site selected for a ground water supply has advantages which make it the most appropriate source for the town.

Analysis of water from the flowing well showed it to be very soft and of excellent quality.

The quantity that can be obtained from the immediate locality of the present well cannot be determined until proved by months of pumping, and other wells may be needed to intercept all of the water that may be required; but the surroundings indicate that a sufficient quantity, for a long time in the future, may be brought to a pumping station in the vicinity of the present well.

The Board advises that water taken from the ground should, when stored, be in a reservoir from which light is excluded.

FAIRHAVEN. The Fairhaven Water Company having applied to the Board for its advice with reference to the taking of a ground water supply from a well near an ice pond, the Board examined the locality and concluded that the proposed source did not present indications which would warrant a sufficient supply for the town, and so advised the applicants. A second application was received by the Board from the same company Dec. 18, 1888, which will receive due consideration.

REVERE. The Revere Water Company at present supplies the towns of Revere and Winthrop with water from a well situated in the former town. The present source cannot be regarded as sufficient for the needs of these growing towns.

The company, being desirous of increasing its source of supply, proposed to take water from Pillings Pond in the town of Lynnfield, and therefore made application to the Board for its advice relative to that pond as a source of supply. The pond in question is a mill pond, with an average depth of not more than three or three and one-half feet. The Board submitted the following reply: —

The amount of water now supplied to the towns of Revere and Winthrop is as much as the present source of the Revere Water Company can be expected to furnish, and an additional supply for these towns is needed.

The water of Pillings Pond, the proposed source of additional supply, when examined in October, 1888, was of fair quality; but, from the small depth of the pond, it will probably be unfit for use when drawn down two or three feet during the dry months, as it would be if used as a water supply for Revere and Winthrop. The quantity of water which it will furnish will not probably be sufficient to furnish a supply to these towns for more than ten years.

In view of these unsatisfactory conditions, the Board advises that a better source should be sought.

The most available territory for the supply of Revere and Winthrop appears to be in the Saugus valley, and the Board would advise that examinations be made to determine if an underground supply may not be found in this valley, above the brook which enters the river from ne village of Wakefield.

BROCKTON. On the 29th of March, 1888, the Water Commissioners of Brockton applied to the Board for its advice as to the methods to be adopted to "effect a permanent improvement in the condition of its water supply," the condition of the water in the previous season having been such as to make it "unfit for domestic purposes."

The Commissioners had already adopted certain measures, such as cutting off the shallow flowage and removing muck, loam, and other material from the immediate shores of the reservoir.

As the result of examination of the Brockton water supply, and of subsequent experiments having in view the best method of relief, the Board transmitted to the Commissioners the following communication: —

In response to the request of the Water Commissioners of Brockton of March 29, 1888, that the State Board of Health would advise them as to what method they should adopt to effect a permanent improvement in the water of their city, which was unfit for domestic use in August and September of last year, the State Board of Health has had examinations made, which show that the probable cause of trouble was the growth and decay of vegetable or animal matter, which growth is favored by the large area of meadow and swamp lands which drain into the reservoir the water which they receive from the adjacent uplands.

Two possible methods of relief are presented: —

1. To prevent the growth of objectionable substances.
2. To remove them and their effects after they have grown.

If there were no meadow lands overflowed by high water, or swamps draining into the reservoir, the objectionable color would undoubtedly be absent, and there would be much less liability to trouble from vegetable growths, although surface waters nearly colorless do sometimes give trouble.

To remove the vegetable matter of the swamps on the stream entering the reservoir would probably be unavailing, because bodies of shallow water would thus be formed in which objectionable vegetable growths would again start. At least, the cost of remedy in this direction would be too great to be undertaken until after less expensive methods of relief have been tried. In lieu of this the Board recommends that surveys and estimates of cost be made by the city upon a plan for conveying the water from the uplands to the reservoir, without having it come in contact with the meadows and swamps, except as it passes through or around

them in channels; the general features of this plan being as follows: —

The isolation by means of dykes on all sides of such portions of the swampy land at the head of the reservoir as are lower than the highest level reached by the water in it; a sufficient channel to be formed on one side of the valley outside of the dyke to carry the maximum flow of the stream, and a smaller channel on the other side to carry the water from uplands in the immediate vicinity. Every other meadow or swamp from which water flows to the reservoir to be provided with a main channel, which may be in the central portion, large enough to convey the ordinary high-water flow of the stream passing through it; and with smaller channels around its borders, and cross channels to catch and convey the water from the uplands to the main channels without flooding.

Such a scheme would undoubtedly improve the water, but we are not ready to advise its adoption until the cost is determined.

Of the second method of relief, that of removing objectionable organisms after the water has received them, natural filtration through the banks of the reservoir or of the stream appears to be out of the question, on account of the impervious nature of the ground.

Experiments have been made by the Board at Brockton and elsewhere with various appliances for rapid artificial filtration through sand, with and without the help of alum. These filters have acted continuously, except when the filtering material was being washed.

In all of these experiments, when sand alone was used, the number of organisms was somewhat reduced, sometimes to one-third and sometimes to one-quarter; but with the deeply colored Brockton water of August and September the filtered water had the same appearance as the water of the reservoir, and the chemical analyses showed a very imperfect removal of the green growth. Such filtration would not be at all satisfactory.

When alum is used with the sand, the number of microscopic organisms is reduced to a greater degree, depending upon the amount of alum used. The ordinary amount claimed to be used was one pound of alum for twenty-five thousand gallons of water. The experiments showed that this amount had no effect upon the color, and had reduced but little the number of bacteria; neither was the color reduced by two pounds, but four pounds reduced the color and the number of bacteria a little more than one-half, and reduced the microscopic organisms to about ten per cent. Six pounds of alum for twenty-five thousand gallons of water

reduced the color to one-eighth of its original depth, reduced the bacteria to one-tenth, and the microscopic organisms to one per cent. of the original number; but there was added to the water a large amount of ammonia, and about one part in one hundred thousand of combined sulphuric acid. The appearance and taste of this water was satisfactory; but the Board of Health cannot advise the use of water which has passed through and dissolved this amount of alum.

Filtration through beds of sand, as practised in the past, has not been sufficiently effectual in removing from water the coloring matter that comes from swamps and microscopic and other vegetable growths to warrant the Board in advising its adoption.

The Board has been engaged in experiments during the past year upon intermittent filtration through five feet in depth of sand, by which it is found that all color and all vegetable organisms which can be identified by the microscope are filtered out continuously where two hundred thousand gallons per acre are filtered daily; but that when four million gallons per acre per day were applied the color was removed for three months, but afterwards increased to be nearly as distinct as that of the applied water, and the number of microscopic vegetable organisms which came through became large, though most of the forms regarded as especially objectionable were much reduced in number.

These experiments give promise of a practicable solution of the problem. They indicate that with certains sands the color and objectionable growth in water from swampy territory may be removed by intermittent filtration from sufficient quantities to render the cost of preparation and maintenance a reasonable one, and experiments will be continued until a definite result is reached.

If the Water Commissioners of Brockton desire that sand from a locality that will be available for use near the reservoir in Brockton be included in these experiments, and will furnish at the experimental station of the Board at Lawrence eight barrels of sand selected by the engineer of the Board and the Water Commissioners, the efficiency of this sand in removing color and vegetable organisms from water will be determined.

KINGSTON. In the town of Kingston there are at present two water supplies, one of which, supplying water for about forty or fifty families, has for many years conveyed its supply to the houses for a considerable part of the distance in a lead pipe one and one-half inches in diameter. As there was some apprehension in the town lest injury might occur

to the persons using this water, it was thought best to refer the matter to the State Board of Health. It was stated that in certain instances persons who used the water had been made ill. So far as could be learned, however, the symptoms which had been referred to this cause were not indicative of lead-poisoning.

Samples of the water were obtained from the pipes at Kingston, and submitted to chemical analysis. The result of the analysis indicated that the water was dissolving quantities of lead, so minute that they could not be regarded as injurious to health; but the fact that any lead was dissolved by this water may imply that under certain circumstances the quantity of lead contained may be large enough to become injurious, and we are glad to learn that since the date of this inquiry the works of the Aqueduct Company have been bought by the town of Kingston, and the use of the lead pipe discontinued.

Gardner. A communication was received from the Board of Health of Gardner, with reference to the pollution of its water supply from the following sources: —

1. Sewage and waste water from a number of dwellings on or near the banks of the supply.

2. Sewage and waste water deposited in and flowing through a swamp near Green Street, and the overflow thereof.

3. Drainage from a cemetery on the north side of the lake. The outlet of the same lake is used by several large factories as a common sewer. A large pond on the line of the same stream is rapidly becoming polluted, and is a source of sickness.

To this communication the Board replied that the conditions referred to as existing at Gardner were such that the local Board of Health could deal with the question. The lakes or ponds referred to in the letter were entirely within the limits of the town, and therefore within its control under the existing statutes. At the same time the Board expressed its willingness to render any assistance to the local Board which the latter might require in dealing with the questions referred to in its communication to the State Board.

Other applications, received from the authorities of Malden, Leicester, Canton, Pittsfield, North Adams, Fairhaven,

Revere and Avon, with reference to water supplies, are still under consideration.

Advice to Cities and Towns Concerning Sewerage and Sewage Disposal.

Brockton. In the report of last year reference was made to the question of the sewage disposal of the city of Brockton (19th Annual Report of the Board, 1887, p. 19), and in the preliminary reply then made to the authorities of Brockton it was stated that a more detailed report would be made at a future time. The Board, therefore, made the following reply on Feb. 8, 1888:—

The Joint Standing Committee on Sewage and Drainage of the city of Brockton, in July last, asked the advice of this Board as to the best practicable method of disposing of their sewage, and proposed four methods of disposal, as follows:—

1. Upon land at the muster-field, as proposed by Phineas Ball, C. E.

2. Upon land at the Matfield meadows, as proposed by Rudolph Herring, C. E.

3. By a process patented by Mr. Amasa Glover of Brockton.

4. By conveying the sewage to tide-water, either at North River or at the Taunton River below Taunton.

The practicability of each of these plans has been carefully considered by the engineer and the consulting engineer of the Board, and the plans which they regarded practicable have received much personal consideration by members of the Board.

The nearest point on North River which can be considered is below the mouth of Third Herring Brook, thirteen and a half miles from Brockton, to which sewage could be pumped through a force-main costing as much as $160,000; but at this distance the low-water flow of the stream would be but six times the amount of sewage, and a nuisance would be produced in this tidal stream which could not be allowed.

To convey the sewage to Taunton River, below Taunton, would, if following the valley, require a sewer about twenty-five miles in length, and it is doubtful if any line could be found which would not require pumping. If the volume of water flowing in the river below Taunton would sufficiently dilute the sewage of Brockton, alone, it will not dilute sufficiently the sewage of Brockton and all other places having an equal or greater right to discharge their

sewage there. The cost of carrying the sewage to this point would be very much greater than to dispose of it upon land, without giving as favorable results.

Mr. Glover's scheme was referred to our engineer, who, after careful consideration of the method and interviews with Mr. Glover, reports as follows: —

"Mr. Glover's original scheme, as far as it relates to the purification of sewage, consists of three principal parts: —

"1. A settling-basin, which, without the aid of chemicals, is intended to separate and retain the solid portion of the sewage.

"2. A wall of gravel at one end of the settling-basin, through which the sewage is expected to filter.

"3. A series of arches of soft brick, over which the sewage is to flow, and through which it is intended to filter, then to drop through the space below, and so become ærated. From this space it is to run through drains to the stream.

"He proposes four divisions of this apparatus to allow for cleaning, etc. All of the apparatus is to be covered with a building having a central shaft or chimney for removing foul odors.

"The scheme, as proposed, is thoroughly impracticable. The settling-basins would not cause the suspended matters to settle to a great extent, and the two filters would not pass a sufficient volume at first, and would soon became clogged."

Mr. Glover also presented an alternative scheme, of a settling-basin and a sub-surface disposal on land; the same scheme in principle as that adopted at the Woman's Reformatory Prison at Sherborn. No details of this scheme are submitted.

Disposal of the sewage of Brockton by chemical treatment or precipitation seems to be out of the question. To carry the sewage to North River, and there treat it, would cost too much; and to discharge the effluent of the precipitation process into the Salisbury Plain River would produce a nuisance.

The land in the vicinity of Brockton, in which the sewage of the city may be purified, has been carefully studied by our engineers.

The Matfield meadows, in West Bridgewater, to which you have called our attention, have the advantage of being accessible by gravitation, and they include some land of favorable character; but they are subject to overflow, and are composed of river silt, very variable in its character, covered in considerable part by muck, which will allow but little more water than the ordinary rainfall to percolate through it. These meadows, and all adjoining land that can be reached by gravitation, would be entirely inadequate for purifying the sewage of the city without lowering the river, and thorough under-draining, at large expense, and even

then we cannot rely upon a satisfactory result. We do not advise the selection of this tract.

Land to the south of the meadows in West Bridgewater, which would require pumping to the height of about fifty feet, presents much more favorable material and in sufficient area; but it is covered with woods and presents a broken surface. The expense of clearing, grubbing and grading would be greater than with other tracts otherwise more favorable.

The muster-field and adjacent area, amounting to 240 acres, may be reached by pumping the sewage through an iron pipe, about 16,000 feet long, to a height of fifty feet. The formation here is favorable for the purification and disposal of sewage. The surface is comparatively even and flat, and, to a large extent, free from woods and brush; the material is open, being fine and coarse sand of fairly even grain, overlaid by loamy earth, and the water-table is from four to twelve feet below the surface. Very fine sand and hard pan are found at some points beneath the coarse sand, and under-draining will be required. This area is ample for the future disposal of the sewage of Brockton, Easton and West Bridgewater; and, in the judgment of this Board, it is, in topography, in character of material, depth to quicksand and water, distance from habitations, compactness and availability, the best place to dispose of the sewage of Brockton. Objection has been made to the use of this tract by the city of Brockton because it does not lie wholly within the limits of the city; this objection is based upon a principle that, in the judgment of this Board, cannot be applied in this Commonwealth. It is as impracticable as to require a city to be limited to its own area to obtain its drinking-water. In the present case there are seventy-two acres of the muster-field area of good quality within the limits of Brockton; this area would, in the judgment of this Board, serve to purify 1,000,000 gallons of sewage daily by intermittent filtration, and it may prove sufficient for 2,000,000 gallons of sewage. There are in addition to this area, across, or on the easterly side of the stream, three tracts of land, containing in all fifty-two acres, not so well adapted to the purpose as the muster-field; neither the surface, the material, the level of the water-table, nor the remoteness from habitations are so favorable, but it may serve for purifying 750,000 gallons of sewage per day.

We conclude that the best place to dispose of the sewage of Brockton is upon land in the muster-field area, including seventy-two acres within the limits of Brockton, and as much more for future use in the towns adjacent; because the disposal can be made there at less cost and more satisfactorily, and because fewer

people will be injured or inconvenienced than at any other place; but that, if the desired area beyond the city limits cannot at present be had, the area of 124 acres above-mentioned within the city limits may be adopted.

The Board of Health has not thought it necessary to urge upon the city of Brockton the adoption of a proper system of sewerage, because all of those representing the city who have communicated with the Board, and the action of the city government in taking advanced ground in endeavoring to start with the best possible plan for the future health of the community, have indicated the general appreciation of the urgent necessity of a proper system of sewage disposal; and we think it necessary to add but one point resulting from our investigations at Brockton, viz.: that the early adoption of a system of sewerage is demanded, not only for the improvement of the sanitary condition of the city, but for the removal of the present pollution, now quite serious, and the prevention of still further pollution of the stream flowing through the city, which contributes to the water supplies of the State farm at Bridgewater, and of the city of Taunton.

Should the city desire more definite information in regard to the ability of the material at the muster-field to purify sewage, and will send fifty cubic yards of it, selected by the engineers of the Board and of the city, to the experimental filter station at Lawrence, the Board will have sewage applied to it daily, and determine how much sewage can be thus applied to an acre, without nuisance at the surface, and with an effluent suitable to flow into a drinking-water stream.

WARE. The Road Commissioners of the town of Ware, early in 1887, applied to the State Board of Health for the advice of the Board relative to the sewerage and sewage disposal of that town. After certain preliminary advice had been given relative to methods of procedure, plans were presented to the Board Feb. 25, 1888, and the Board at its next meeting replied as follows: —

In reply to your communication, submitting revised plans for the sewerage of Ware, the State Board of Health recognizes the care which has been taken to provide the best system of sewerage for the town of Ware, and approves, generally, the plans and report presented Feb. 25, 1888, subject, however, to the following criticisms: —

The discharge of storm-water into the canal leading to the

works of the Geo. S. Gilbert Manufacturing Company is approved, only upon the condition that the said company does not object.

The storm-water sewer from the Aspen Street district appears to be too small; and, when enlarged, it will probably be cheaper to connect it with he sewer at the foot of North Street, and provide a larger main from this point to the river.

Some minor features of importance as matters of detail, but not affecting the general system, would have been examined and reported upon had not your consulting engineer informed us in his letter accompanying the plans that he should advise some slight changes, which, to avoid delay, had not been made before submitting the plans, and that an answer from this Board was desired before the March town meeting.

Haverhill. The authorities of the city of Haverhill having applied to the Board for its advice with reference to the sewerage of a certain district in that city, in the neighborhood of Little River, the Board replied as follows: —

The Board approves the general features of the proposed plan for preventing the discharge of sewage into Little River, but would suggest the following changes, if they are found to be feasible, after examinations and plans have been made by your engineer: First, that the dry-weather flow of the Emerson and Merrimack Street sewers be diverted to the main intercepting sewer on the westerly side of Little River; the present outlet of these sewers to be retained for the discharge of storm-water, and the proposed outlet to the Merrimack not to be built. Second, that the dry-weather flow from the main intercepting sewer be carried out into the river by a submerged pipe or pipes.

Winthrop. The town of Winthrop, by its selectmen, requested the advice of the Board, in 1886, relative to a separate system of sewerage for a part of that town, the plan involving the disposal of its sewage into the outgoing tide upon Winthrop Bar, at a distance of one thousand feet from the shore.

The plans, "presenting unusual features, were the subject of much consideration by the engineers and members of the Board. The Board advised several changes in details, chiefly those relating to the sanitary features of the scheme; but, with these changes made, they approved the scheme of

sewerage as one well adapted to the present condition of the town, and capable of meeting its needs for several years to come." [18th Annual Report of Board, 1886, p. 1.]

The town subsequently submitted a different plan, providing for discharge of the sewage near the inland shore of the peninsula into Snake Island channel. The Board expressed its disapproval of this method in the following reply: —

By report of this Board, made to the town of Winthrop in November, 1886, it will be seen that the Board concluded that the best place to dispose of the sewage of the town would be into Shirley Gut, but that the expense caused by the necessary pumping would be too great for the town at present, and the Board approved a less expensive method of disposal.

The scheme now proposed, as understood by the Board, is to pump the sewage and discharge it into Snake Island channel inside of Point Shirley.

If the sewage is to be pumped, it can be conveyed to Shirley Gut at less expense than to Snake Island channel, and Shirley Gut is much preferable as a place of disposal; hence, the Board does not approve of the plan proposed.

PITTSFIELD. The Fire District of Pittsfield having petitioned the Legislature for authority to construct a system of sewerage for that town, the method of disposal to be submitted to the approval of the local board of health, the question was finally referred to the State Board under the provisions of the general Act of 1888. The advice of the Board being requested upon the subject, since the question involved to some extent the interest of other towns situated upon the Housatonic River, below Pittsfield, a public hearing was granted at the town hall in Pittsfield on April 20, 1888, and the towns interested were notified. The town of Pittsfield was represented by its committee on Sewers and its Board of Health and other citizens, and the towns of Lenox and Lee were also represented. Special reference was made at this hearing to the prevalence of malarial fevers along the banks of the Housatonic River below Pittsfield, and the possible effect of the sewage upon the prevalence of the disease. Objections were urged by Lenox and by Lee to the direct use of the river by Pittsfield for its sewage disposal. On the

other hand, the town of Pittsfield urged the necessity of immediate relief in the form of some outlet for its sewage, certain districts, like that about Silver Lake, into which the sewage of the jail overflows, requiring special attention. The Board gave the following reply: —

The State Board of Health, in response to the application for advice made by the committee on the Jail Sewer of the Fire District of Pittsfield, dated Feb. 1, 1888, has carefully considered the subject of the disposal of the sewage of Pittsfield, has by its members and its engineers examined the locality, and has given a hearing at Pittsfield to the authorities and others of this town and of other towns interested, and now presents the following advice: —

Pittsfield Fire District is supplied with water, and as a necessary consequence must be supplied with sewers. Malaria has in years past appeared upon its borders, indicating that some of the conditions there exist by which it may be induced to become permanent, and it is necessary that the inhabitants of the valley should take all reasonable precautions to prevent its recurrence. The authorities, as well as the intelligent citizens, believe that it is dangerous to the health of the community to turn the sewage into the river above the mill-dams, for they find the mill ponds become foul with deposits of filth; and they have wisely concluded to continue their discharging sewers down the valleys to points below the lowest dams in the town.

The inhabitants of Lenox, the next town below on the river, are concerned lest the sewage which is to be poured into the river below the mill-dams in Pittsfield may contaminate the water, and cause foul deposits in the long mill-pond, which extends nearly the whole length of their town, and on the borders of which malarial fever has prevailed in past years.

The possibility of such a result certainly deserves careful consideration. Such a result is evidently more remote than the experience of Pittsfield has proven to exist where sewage and other refuse have been poured into its own mill-pond, because it is distributed over a larger area, and becomes diluted by the several streams of pure water which flow into the river in this nine miles of its course. By comparison with other rivers of the same quantity of water, into which are poured sewage and refuse from a population similar to that of Pittsfield and its vicinity, it is evident to this Board that the time is not far distant when this river will become so polluted that it can no longer be allowed to receive the sewage of Pittsfield.

The State Board of Health advises the Pittsfield Fire District to have a careful examination made by a competent engineer, that he may select the most desirable tract of land of about one hundred acres for a filtering area, to which the sewage of the town may be pumped when it becomes needful.

That main sewers, properly proportioned to take all of the sewage of the thickly settled parts of the town, be designed to convey the sewage to a common point, from which it may be pumped to the filtering area. Plans of such main sewers being presented, the Board will advise the Fire District as to the scheme in general, and as to the place where temporary outlets may be made into the river.

The Fire District can then, as it becomes necessary, construct its sewers from time to time in accordance with the general plan, and avoid rebuilding expensive work.

It is evident that in the proposed sewer discharging below Van Sickler's dam, a large expenditure is to be made in the long, deep cut near the lower end.

It may result from the investigation and design for the complete system which is advised, that this section will be essentially modified and the cost decreased; while, if it should be constructed as is now proposed, it may prove unfitted to form a part of the completed work, and be in future abandoned. As the specific questions asked by the Fire District can, in the view of this Board, be answered satisfactorily only in connection with the general plan herein proposed, their answer is deferred until they shall have received such plan.

Framingham. Under the authority of a special Act of the Legislature (chapter 493, Acts of 1887), the town of Framingham was authorized to introduce a system of sewerage, the method of disposal to be approved by the State Board of Health. In accordance with the provisions of this Act, upon application from the town of Framingham, the Board gave a public hearing, after due notice as required by the Act, at which the towns of Framingham, Natick and other adjoining towns upon the Sudbury River, and also the city of Boston, were represented. The Board visited the proposed location of the field for sewage disposal, and after careful examination by its engineers of the plans presented by the town, gave the following reply: —

In response to the application from the town of Framingham, of

March 1, 1888, giving notice of their intention to introduce a system of sewerage, and asking advice as to the best practicable method of disposing of their sewage, and approval of the plan presented pursuant to chapter 493 of the Acts of 1887, the State Board of Health, after fourteen days' notice by publication in the newspapers of Framingham and Natick, and official notice in writing to the selectmen of the town of Natick of the presentation to it of such system for its approval, gave a public hearing at the State House in Boston, on the 24th day of April, to all interested in said system; and after careful examination of the plans presented, and of the proposed location of grounds for sewage disposal, and their surroundings, both by personal examination and by its engineers, this Board approves of the disposal of the sewage of Framingham by irrigation and intermittent filtration, upon the tract of land containing sixty-eight acres, selected by the town, which is located in the town of Natick, on the northerly side of the Worcester turnpike, and outside of the Boston water-supply basin.

As the method of disposal of the sewage upon this tract is not presented by the town with sufficient clearness to enable this Board to approve or disapprove of the same in detail, the Board therefore approves the system as modified and amended as follows: The sewage should be applied to so much of the surface of the tract of land as is more than four feet above the level in summer of the water in the brook draining the tract; and at or near this height, on the slope toward the brook, and near the lower border of the tract upon which sewage is to be applied in those sections not sloping directly towards the brook, there shall be constructed an embankment of earth, at least one foot high above the adjacent surface to which sewage is to be applied, and four feet wide, which shall at all times be maintained at such height as to prevent any sewage applied to the surface from flowing over the surface of the ground into the brook or on to adjoining land; and the Board further amends, by directing that the top of the underdrains to convey effluent from the filtration or irrigation areas shall be not less than four feet below the surface of the ground to which sewage is applied; and the Board further amends by directing that the quantity of sewage to be applied to any filter-bed or irrigation area shall not exceed in any week the equivalent of one foot in depth over the whole area of that bed or irrigation area to which it is applied, and the times of application shall be so arranged that no liquid sewage shall remain exposed upon the surface or in open ditches more than twenty-four hours at a time. It is understood that the receiving reservoirs are to be completely covered, and be ventilated by flues extending to the flue of the chimney of the

pumping station, and that both reservoirs and pumping station are to be located within the town of Framingham.

As herein modified and amended, the proposed system of sewage disposal and its location are approved.

WESTFIELD. The town of Westfield, through its committee on sewerage, applied to the State Board for advice in regard to a proposed system of sewerage, and the Board, after examination of the proposed system, replied as follows: —

The plan presented recommends definitely that the main sewer for the northwestern section of the town should pass through Elm Street and discharge into the river a short distance below the dam. To this plan the Board finds serious objections, in that such outlet would be at a point in the river where, in the great freshet of 1878, the water of the river stood at such height that it would back up through the sewers and turn the sewage into the cellars of a large section of the town; and that an outlet for this section, quite as favorable as regards expense, can be found farther down the river, where the water in the great freshet stood at a level five feet below that at the proposed outlet.

The plan presented suggests two other main sewers to serve other districts of the town, but these were not definitely recommended, as the information at hand was considered insufficient.

The time may come when it will be necessary to withhold the crude sewage and subject it to some purifying process before discharging into the river. The Board does not see immediate demand for such purification in this case, but would advise giving consideration to such future demand in designing the new system.

The conditions of the town are such that it is probable that the storm-water of large areas can be conveyed directly to natural channels where it will never give offence, and the sewage can be conveyed in small pipes to suitable outlets, more satisfactory than by first polluting the storm-water by sewage, and trying to remove the whole to an unobjectionable outlet.

The question, to what extent the sewage should be kept separate from the storm-waters, demands a careful investigation, taking in view the future disposal of the sewage and the comparative cost.

Considering the information furnished by the great freshet, the growth of the town in the fifteen years since the present plan was made, the experience that has been gained with reference to the separate system of sewerage, and the limitation to the pollution of streams, which consideration of the public health is imposing more

and more as the population of the State increases, the State Board of Health recommends that you have the question of the sewerage of the town reconsidered upon the general basis herein presented, and new plans made by some engineer skilled in this kind of work.

The town has adopted the recommendation of the Board so far as to employ an engineer to report a plan of sewerage upon the separate system, and the report is under consideration by the town.

QUINCY. The town of Quincy, through its committee on sewerage, requested the advice of the Board with reference to the best method of disposing of its sewage, and the Board replied as follows: —

The disposal of the sewage of the main village and the southern and western sections of the town into Weymouth Fore River, is approved by the Board.

It now appears that the best point of discharge is into the channel under the bridge by a pipe having its end below low-water mark. The exact location of the outlet at the Point, however, should be definitely determined only after the currents have been ascertained by observing the course of floats at all stages of the tide.

The discharge of sewage from the low district north-east of the main village, referred to in the report of Mr. E. C. Clarke, including less than one hundred acres, into the head of Town River Bay, is permissible, provided the amount of sewage discharged there is limited to the ordinary sewage that may be expected from this low area.

The Board, from present information, thinks it preferable that the sewage from Wollaston and Atlantic should be carried to a low-water channel in Quincy Bay, about three thousand feet from the shore, rather than into Neponset River; and advises the town to have the necessary examinations made to determine the currents, the cost and efficiency of sewer systems connecting with each of these outlets.

The Board does not advise the disposal of the sewage at Hough's Neck.

Any information which the engineer of the Board may have obtained in this examination will be placed at the service of the town.

NORTHAMPTON. Under the provisions of chapter 354 of the Acts of 1888, the city of Northampton was authorized to construct a system of sewers. The Commissioners of Sewers requested a conference with reference to certain questions relative to its sewerage and sewage-disposal. The Board was represented at this conference, and on examining the plans and proposed location, replied to the application of the Commissioners as follows: —

We find that this Board cannot approve any system of sewage-disposal for any part of the city of Northampton, except acting under chapter 354, Acts of 1888, which makes it the duty of the Sewer Commissioners to first adopt a system for the said city.

Upon receiving application from the commissioners for a conference, the chief engineer of the Board of Health visited Northampton, and has made to the Board the following suggestions which result from his examinations there, and which we transmit for your consideration: —

"With regard to what the city ought to do, I will suggest that it should have the question further investigated, with the view of carrying the sewage to the Connecticut River, or to some high, porous portion of the meadows, well away from habitations, or to some porous upland. This would apply not only to Northampton village, but to the other villages. Even if it were decided to go to the river, purification of the sewage might be required in the future, owing to the increasing demand for pure streams; and the contingency should be kept in view in the present work.

"The villages up the river, and the portion of Northampton village which drains directly into the river, are so situated that the separate system would probably be the most efficient and economical, owing to the fact that the sewage will have to be carried long distances to a suitable outlet, or disposed of upon land.

"The system to be adopted for that portion of Northampton village which naturally drains through the King and Market Street brooks, near the railroad, is more difficult to determine, and can probably be settled only after estimates have been made of the cost of three different schemes, taking into account the sewers and covered brook channels already built.

"These schemes are: —

"1. The separation of the sewage from the street and brook water.

"2. The combined system, with medium-sized main sewers, and

large covered channels for the brooks, with overflows from the former into the latter.

"3. The combined system, with large main sewers of sufficient capacity to carry the sewage, street and brook water.

"In devising these schemes the feasibility, from both an engineering and a legal standpoint, of diverting a part of the brook water at the N. H. & N. R.R. in a northerly direction to the Connecticut River, should be determined and taken account of.

"The separate system for this portion of the town would have some advantages in diminishing the size of the main sewer from the mouth of the brooks to the Connecticut River, and as this sewer would necessarily have a light grade, it would be much more easily kept clean with such a system. Should the brooks be intercepted, the amount of gravel brought to this sewer might be so great as to obstruct it. In the event of the disposal upon land, the advantages of the separate system are obvious."

Since there appeared to be special need of relief for a certain district of the city in the shape of a storm-water drain to carry away the water which has frequently flooded that section, the only means then in use being a conduit of insufficient size, a plan was presented to the Board by the Sewer Commissioners having reference to the district in question, and the Board replied as follows: —

The Board of Sewer Commissioners of Northampton, by their engineer, presented on the 25th of September a plan for a storm-water drain running through State Street northerly to Connecticut River, to convey storm water permanently for an area of three hundred acres and to take temporarily the sewage which comes from the sewers which it now intercepts, but it is definitely stated by the engineer of the commissioners that all the sewage now to enter this drain is to be cut off and otherwise disposed of by a system of sewers which the commissioners are now preparing, to be hereafter presented to the Board.

Such disposition of storm water and surface drainage is satisfactory to the State Board of Health.

An alternative plan was spoken of by the engineer of the Commissioners, though not presented fully. It was understood to be a large sewer running southerly from the thickly settled part of the city to Mill River, and to take, for the present, the storm water from a large section, and a very large part of the sewage of the thickly settled part of the city. The consideration of the

disposal of so much of the sewage of the city for an indefinite time, appears to this board to come properly under the Act creating the Board of Sewer Commissioners, and we see no way of entering upon it except by the method prescribed by that Act.

LENOX. The town of Lenox, finding its method of sewage-disposal entirely inadequate to the wants of the town, appointed a Committee on Sewerage and applied to the State Board for its advice with reference to a method of disposal upon the easterly slope of the town upon land west of the Housatonic River. The Board, after considering the plan, replied as follows: —

Upon considering the plan for the disposal of sewage, presented by the town of Lenox, the State Board of Health finds that the town has purchased about twenty-three acres of land upon which to dispose of about three-fourths of its sewage, and has already expended considerable sums in building main sewers to this tract, and in preparing the tract to receive sewage.

The material of this tract appears to be very unfavorable for filtering sewage, being permeable by a very small quantity of water and of air; and, had application been made to this Board before much work had been done, which is applicable only to this tract, the Board would have advised seeking a tract better adapted to the purpose. It is, however, possible, that by thorough under-drainage, this tract may be made to take care of all of the sewage which may come to it. In the present condition of affairs, it appears best to try this tract by preparing as much area as is deemed necessary to filter the sewage immediately to be disposed of; and, if it proves unsatisfactory, to seek better material north of the road leading from Lenox to the railroad station, or across the river, or elsewhere.

The details of the filtration area construction have not been fully presented, and, consequently, no judgment is expressed upon them. There is, however, presented upon the plan a direct connection, controlled by a gate, between the main sewer from the town and the main underdrain leading to the river above the dam. This arrangement, presenting so ready a means by which a negligent manager of the filtering area could discharge the crude sewage of the town directly into the mill-pond, should not be allowed.

FOXBOROUGH. The Selectmen of the town of Foxborough applied to the State Board with reference to the disposal of

its sewage, either into the Neponset Reservoir Pond or into Robinson's Brook, in that town, to which the Board made the following reply: —

In response to the application of the town of Foxborough for advice in regard to the disposal of sewage, the State Board of Health advises that the sewage of the village should not be discharged into Neponset Reservoir nor into Robinson's Brook.

It is understood that a water supply will probably be introduced before many years, when a sewerage system will be required for the whole village, and the Board of Health advises that the town have prepared a plan of sewers for the village, such sewers to be of small pipes, to be used only for the conveyance of sewage, the storm water to be discharged into the natural channels, and the sewage to be conveyed to a suitable tract of land to the south of the village to be selected by your engineer, where by intermittent filtration the sewage may be treated without offence.

HOWLAND MILLS CORPORATION. This corporation, located near Clark's Cove, in New Bedford, applied to the Board for its advice with reference to the disposal of its sewage, principally that from a group of tenement houses, to which the Board replied as follows: —

Two plans of sewerage for the Howland Mills Corporation have been presented by them for advice; one, a separate system, another, a combined system, both discharging into Clark's Cove at the level of low water.

It appears that the immediate expense attending the separate system will be much less than that for the combined system; and, that before the time when the large sewers of the combined system will be used to their full capacity, the public welfare may require that sewage should be carried farther from the shore or excluded from a cove having no stronger tidal currents than Clark's Cove.

The State Board of Health advises that the separate system be adopted, both for the saving of present expense and the avoidance of future expense, greater than necessary, should changes in the disposal of sewage be required in the future.

CHARLEMONT. Citizens living in the village of Charlemont were desirous of constructing a sewer to relieve their premises of the bad drainage from which they were suffering.

The householders seeking relief were few in number and lived in that part of the town situated east of Mill River. Application was made by them to the Board for its advice relative to the disposal of their sewage into Mill River, and the Board, after examination of the premises, made the following reply to their request: —

Your application to this Board for its advice in regard to the disposal of sewage from a portion of the town of Charlemont, situated east of Mill River, has been received and considered by the Board, and, in consideration of the comparatively small amount of sewage to be contributed by the proposed sewer, as compared with the daily flow of Mill River, and also in consideration of the almost daily flushing of the river below the dams, the Board approves the plan of discharging the sewage at the bridge, provided its outlet shall be so constructed as to be constantly under water. Such method of disposal should be considered as a temporary method, since, in case of a considerable increase of the population of the district in the future, it may become necessary to carry the outlet to the Deerfield River.

Newburyport. The authorities of Newburyport having, through their engineer, devised two plans for their sewage-disposal, applied to the Board for its advice, to which the Board replied as follows: —

In response to the application, dated Oct. 22, 1888, of the city of Newburyport, by its Sewerage Committee, for advice as to the best practicable method of disposing of its sewage, the State Board of Health has considered the general features of the two plans submitted, has caused examination to be made upon the ground by its chief engineer, and hereby transmits its approval of the general features of the plan providing for the interception of the sewage by a sewer parallel with and near the Merrimack River, and for the discharge of the sewage into the main channel opposite the lower portions of the city.

Clinton. The town of Clinton through its Road Commissioners requested the advice of the Board with reference to its sewerage and sewage disposal, as stated in the Nineteenth Annual Report of the Board, page 18. The Board recommended that the sewage be purified before the effluent should be admitted to the Nashua River.

Information was subsequently received that the town was constructing sewers which would admit its sewage to the river without such purification. The Board, therefore, requested information from the town authorities as to the truth of the statement.

The following reply was received from the solicitor of the town of Clinton: —

The town of Clinton is placing large sewers in certain of its streets and perhaps placing new ones in a few others.

It is intended that these sewers shall empty where other like sewers have emptied in the past, to wit: into the Counterpane Pond in Clinton, Mass., far from the Nashua River. The waters of this pond eventually get to the Nashua.

This method of drainage and disposition of sewage has been in vogue since the incorporation of the town. The sewers are so few in number that no main sewer is contemplated.

I ought perhaps to add that the town of Clinton never authorized any one to consult your Board under the provisions of chapter 274 of the Acts of 1886, but nevertheless is disposed to do everything in the disposition of its sewage that progress demands or science sanctions, and would be pleased to adopt any known practical method of purification, but is nevertheless indisposed to experiment for the benefit of others with a matter that has thus far found no satisfactory solution.

No action has been had by the Board since the receipt of this letter; but it seems proper to report the matter to the Legislature.

The following municipalities have also submitted applications for the advice of the Board relative to sewerage and sewage disposal, which are still under consideration: Winthrop and Gloucester.

II.

EXAMINATION OF WATER SUPPLIES.

The regular monthly chemical examination of the water supplies of the State was begun in June, 1887. A brief account of the character of this work was given in the report of the Board last January. It has now been carried on for nineteen months, and is still in progress. The results, which have been tabulated in the Supplement,* are of the highest value. The information which is there given regarding the changes in the character of surface waters in different seasons of the year, and under various conditions of temperature and rainfall, could have been obtained in no other way. Occasional examinations of the waters of rivers and lakes may fail to detect essential peculiarities of character and change, which a regular and systematic examination of the waters, covering a long period, will be sure to reveal.

The methods of analysis employed will be found in the report of the chemist in charge of the examination of the water supplies, together with a discussion of the subject of the interpretation of the results obtained.

These tables, in the Supplement, contain under each water supply, in addition to the chemical analyses of the water, month by month, the statement of the most prevalent forms of animal and vegetable life, as far as they have been determined, and a general description of the source of the supply. They are valuable not only for the information which they give as to the character of each supply during the months in which they have been examined, but for the important information of a general character which they

* The detailed results of examination of the several water supplies of the State, and of the results of experiments upon filtration of sewage, will be published in the form of a Supplement, which will soon follow this report.

will reveal, when studied as a whole, with regard to the nature and composition of waters under varying conditions.

Some of the information gained by this study will appear in the following considerations: Surface waters, including the flowing water in streams and the still waters of lakes and reservoirs, contain matter of vegetable and animal origin in solution, and also carry in suspension animal and vegetable organisms, which go through the usual changes consequent on life, death and decay. In the chemical analysis of these waters we determine the nitrogen of the organic matter in four forms, namely, ammonia, albuminoid ammonia (or organic nitrogen), nitrous acid and nitric acid, and thus learn whether the organic matter is in a stable condition or whether it is undergoing change. Subsequent examinations of the same sample of water, at intervals of several days or weeks, tell us, also, of the rate of change. We have no certain and simple means of knowing whether the nitrogen in any of these forms had a vegetable or animal origin, for both vegetable and animal nitrogenous matters go ultimately through the same series of changes. Further, we do not certainly know under what conditions animal or vegetable matter in the process of change is injurious to health; but so much experience has taught, namely, that there is danger in using water for drinking which has received sewage or the waste products of human life. It is to the detection of such contamination that the present investigation is mainly directed.

The methods employed for this purpose are more or less indirect. When the pollution is considerable there is no difficulty in recognizing it. This is well shown in the examinations which were carried out in the fall of 1888 on the Nashua, Hoosac and Housatonic rivers, and shown on the map of these rivers in the Supplement. The entrance of sewage into the streams was indicated promptly by the rise in the chlorine, free ammonia and the nitrites. As the water flows onward the ammonia and nitrites gradually disappear, but the chlorine remains. Further investigations of this character were prevented by the heavy rains of last fall. They will be resumed next summer and fall when the conditions are favorable.

In any isolated examination of the water of a river or lake it is impossible to say whether it has received injurious pollution (except in extreme cases, like, for instance, the Blackstone River at Worcester), unless the *normal* composition of the water is known. The analyses of the unpolluted waters of Massachusetts show a great variety of composition in respect to their content of nitrogen, and it is manifestly impossible to apply to them all one standard of purity based on the amount of nitrogen they contain. We have, for instance, deep-brown, swamp waters, holding a large quantity of vegetable matter in solution, and pond waters with large quantity of living algæ suspended in them; and, again, colorless waters of ponds, with but very little organic matter in suspension or solution.

Waters of the first two classes are in use as regular water supplies, as well as the last, and although far from being chemically pure, they are not, as far as we know in this State, unhealthy. If we are now asked to say whether a particular surface water is contaminated with drainage, we must know what is the composition of the water normally, or, if we cannot ascertain this, what is the composition of some surface water, which we know to be unpolluted, in the same locality, under the same conditions. In other words, we must have a special standard of comparison for each water. Further, the water from the same lake or river differs at different times of the year, and also in wet and dry seasons, which involves the further necessity of knowing the influence of these varying conditions. The more complete the record of the analyses of the waters of the State, the better are we able to judge what is their normal character.

An interesting practical illustration of this method of comparing waters with normal standards is shown in the "map of normal chlorine" given in the Supplement. On this map is marked the content of chlorine in the unpolluted surface waters of the State. It will be seen that the amount in the extreme western part of the State is about 0.08 parts in 100,000, and that, as we advance eastward, the chlorine gradually increases until it reaches one part per 100,000, or more. The amount of chlorine normally present in these surface waters is thus shown to bear a direct relation

to their proximity to the sea. The presence of chlorine in any water can, therefore, be regarded as presumptive evidence of pollution by sewage, only when it is in amount greater than the normal of its region. If, at the same time, it has high free ammonia and nitrites, the presumption amounts almost to proof.

The "self-purification" of waters, which have been polluted by sewage, has long been recognized by chemical investigation, but there is still a difference of opinion whether a water once polluted is ever safe to drink. In this connection it is important to distinguish between the purification which goes on in the pores of the ground, when surface water filters through the soil, and that which goes on in streams and ponds. In the former case the organic matter is, under favorable conditions, completely oxidized, and we have, as the result, a water which contains no organic matter and no organisms. In surface waters there is also oxidation to a certain extent, but this action is subordinate in importance to the growth of new life out of the decay of the old.

In ground waters, therefore, we have a simple standard of purity, namely, complete freedom from organic matter and from the intermediate products of its oxidation, while in surface water we may have more abundant life as the result of pollution. In the latter case, we can only form an opinion of the fitness of the water for drinking from the *condition* of the nitrogenous matter, — whether or not it is in a state of putrefactive change. This we recognize by the presence of free ammonia and nitrites. In most unpolluted surface waters the compensation between the living and the dead organic matter is such that the products of decomposition do not accumulate, but are immediately assimilated by new growth. This has been experimentally proved in the laboratory by adding living algæ to water which has been polluted by sewage and other decomposing animal matters. There can be no doubt that this growth of plants is as really a process of purification as that of direct oxidation.

Occasionally the balance between growth and decay

becomes disturbed, and the intermediate products of change manifest themselves. In the winter months it is not uncommon to find the free ammonia very high in surface waters, in which, during the warmer months, it is entirely absent. Whether this has any sanitary significance, in waters known to be unpolluted by drainage, is a matter for further investigation.

The question of the fitness of a water for drinking may be said, in a general way, to rest, first, on the presence of specified germs of disease, and, second, on the presence of substances more or less injurious to health, which are formed in the process of the change of organic substances. Of the first-mentioned kind of pollution, chemical investigation gives us no clue; and it is because it is feared that these germs may not be destroyed in the usual natural processes of purification in surface waters, that many claim that it is unsafe under any circumstances to use a water which has received sewage. Of the second kind of pollution, namely, that which depends on the presence of products of change, we can speak with some confidence, since the process of change is one that manifests itself by the formation of intermediate nitrogenous products that we can readily recognize by chemical means. The analyses of the waters of the rivers, above mentioned, afford a good illustration of the recognition of pollution by means of these intermediate products. Of an altogether different character is the brown coloring matter of many surface waters. This has been found to be but very slightly disposed to change, notwithstanding the fact that it is often highly nitrogenous. Leaving out of consideration the question whether this coloring matter is of itself undesirable in a drinking water, it can be safely said that it does not involve the processes of decomposition which we always associate with an unwholesome water.

The continuation of the systematic investigation of the waters of the State, it is believed, will be productive of valuable information concerning the relation of water supply to the health of the community.

III.

FILTRATION AT THE EXPERIMENTAL STATION IN LAWRENCE.

The experiments upon filtration of water and sewage at the Lawrence experimental station have been continued by the Board throughout the year with very satisfactory results, giving additions to the knowledge of the world upon the subject of filtration, and showing, upon a scale large enough to approximate to the conditions of actual practice, the practicability or impracticability of methods heretofore deduced from laboratory experiments.

These results are elaborately presented and discussed in the Supplement by Mr. Mills, a member of the Board, who has had these experiments under his immediate charge.

Some of the general results only will be presented here.

Sewage can be much more efficiently filtered through open sand than through sand covered with soil. Very fine material, like dust, in the upper layers of a filter, prevents free access of air, and, when wet, may exclude air so completely as to render purification impossible. With soil or sand containing dust at the surface, periods of intermission in the application of sewage may be made so long that the surface, becoming dry, may allow air to enter, and a high degree of purification may result; but the quantity of sewage that can thus be purified is very much less than when the upper layers of the filter are composed of open sand, through which the sewage will rapidly disappear, and will leave room for air to enter and come in contact with the thin laminæ of liquid covering the particles of sand.

The experiments of last winter show that intermittent filtration can be carried on upon a bed of coarse sand, through the coldest weather, when the beds are exposed to snow, but that the efficiency of the beds is much reduced by such exposure and the consequently low temperature of the

sewage passing through the sand. By protecting the beds so that snow cannot fall upon them and reduce the temperature of the applied sewage to near the freezing point, the experience of the present winter, so far, indicates that very complete purification may be continued through very cold weather by applying the sewage intermittently at the temperature at which it ordinarily comes from the sewer. The experiments of last winter show that, when the beds are exposed to the snow,.intermittent filtration may be carried on through the moderate weather of winter, alternated by continuous filtration during the colder period.

Filtering areas of sand covered with soil, or areas of very fine sand, may be much increased in efficiency, in both summer and winter, by digging trenches in the direction of a slight incline, about two feet deep and one foot wide and six feet apart, and filling them with coarse sand. The sewage should be applied to this coarse sand, and, once in a month or two, a half inch in depth should be taken from its surface and replaced by clean sand. In winter the trenches should be covered with boards to keep out the snow.

The general results obtained at each of the filters will be briefly stated. To all of them, unless otherwise stated, sewage was applied intermittently at intervals of one or more days, and disappeared from the surface in a few minutes or in a few hours.

Four tanks, filled with clean, coarse mortar sand from the same pit, were subjected to different conditions. One of these was exposed to the cold and snow, and, although it received sewage daily and removed about two-thirds of the impurities of the sewage during the very cold months of January, February and March, when filtering at the rate of 30,000 gallons per acre per day, it is evident, from the results in the other three tanks, which were not exposed to frost, that the sewage entered and passed through but a fractional part of the area of this tank; and the result is as poor as if a much larger quantity had been applied to a like area not obstructed by frost.

The three other tanks were supplied with sewage at the rate, respectively, of 30,000, 60,000 and 120,000 gallons per acre per day; and, until nitrification commenced, in the

latter part of March, — periods of forty-one, thirty-one and twenty-seven days respectively, — the ammonias indicated that 97, 94 and 80 per cent. of the impurities of the sewage were removed.

Nitrification began to increase in all of these tanks between March 26 and 30, when the temperature of the effluent was at 39° or 40°. In the course of three weeks the nitrates had increased from 0.025 parts in 100,000 to 0.250 parts; after which they increased much more rapidly, and nitrification was most complete from May 6 to 10, or six weeks after it began, — the nitrates then amounting to from 2.5 to 3.0 parts per 100,000.

During the increase in nitrification the ammonias also increased for a time, and became nearly one-third of those of the sewage; but, generally, before the nitrification reached its height, the ammonias decreased rapidly, until they became between one-half of 1 per cent. and $1\frac{1}{2}$ per cent. of those of the sewage.

The rapidity of purification, as shown by the decrease in ammonias, was greatest in the tanks which had received the most sewage and had the greatest amount of nitrogenous matter stored in them, — the effluent from the sand which had received the least sewage being more than a month later in reaching its condition of greatest purification.

The filter receiving sewage at the rate of 120,000 gallons per acre per day gave an effluent for three months after purification resulting from nitrification was established, in which the ammonias were less than $1\frac{1}{2}$ per cent. of those of the sewage. Upon increasing the amount filtered to 180,000 gallons per acre per day, the ammonias increased, but for the next four months averaged less than 2 per cent. of those of the sewage.

One of the filters, receiving sewage at the rate of 60,000 gallons per acre per day for seven months after purification was established, gave an effluent of nearly constant quality, having one-half of 1 per cent. of the ammonias of the sewage, the free ammonia averaging 0.0012 parts and the albuminoid ammonia 0.0105 parts in 100,000 parts, showing less organic matter than many of the drinking waters of the State.

The other filter of the same material, receiving 60,000 gallons of sewage per acre per day, gave an effluent for three months after purification was established, having between 1 and 2 per cent. of the ammonias of the sewage, but in the next two months these increased to 6 and then to 10 per cent. This increase was due in part to the imperfect distribution of the sewage over the whole surface, which being corrected, the percentage of the ammonias decreased, and averaged, for December 4½ per cent. of those of the sewage.

The tank of this material, which has filtered at the rate of 30,000 gallons per acre per day, was, as stated, a month later than the others in reaching an established condition after nitrification became active. For the following six weeks the ammonias of the effluent were but 1 per cent. of those of the sewage, and the nitrates were a little more than one part per 100,000.

At the end of this time the outlet was closed and the tank filled with sewage, and for the next four months the surface of the sand was kept covered with sewage, and the outlet was opened each day sufficiently to allow the regular quantity at the rate of 30,000 gallons per acre per day to flow out. The filter was thus changed from the condition of intermittent filtration to that of continuous filtration. During the first month the nitrates were reduced from one part per 100,000 to less than 0.01 part, at which they continued for the remaining three months. The ammonias rose in the first month from 1 per cent. to 1½ per cent. of those of the sewage. In the second month they became 31 per cent., and at the end of the fourth month were equal to those of the sewage.

This shows distinctly the radical difference in result between intermittent and continuous filtration. In intermittent filtration the nitrification was active, and, as shown by the ammonias, 99 per cent. of the organic impurities were removed; while in continuous filtration the nitrification ceased, and the same sand, filtering the same quantity of sewage, stored impurities for a time, but finally poured out an effluent quite as impure as the applied sewage.

From these open sands the number of bacteria in the effluent has, during the past six months, varied from 2 per

cent. to a very small fraction of 1 per cent. of the number of bacteria in the sewage.

A filter of very fine sand, after filtering an amount equivalent to 8,600,000 gallons of sewage upon an acre, filtered at the rate of 12,000 gallons per acre per day, giving an effluent in which the organic matter, shown by the loss on ignition, was but 3 per cent. of that of the sewage; and the nitrogenous matter, as shown by the ammonias, was but one quarter of 1 per cent. of that of the sewage.

The loss on ignition was,	0.5000	parts in	100,000
The free ammonia,	0.0002	"	"
The albuminoid ammonia,	0.0062	"	"
The nitrates,	0.7000	"	"

At the same time the bacteria of the sewage amounted to 591,000 in a cubic centimetre, while those of the same quantity of effluent amounted to 2, and these may have come from the air while collecting the sample.

By both chemical and bacteriological analysis this effluent from sewage has less organic impurity than the water of Lake Winnipiseogee, and contains but little more nitrogenous organic matter than city water filtered through the same material a year ago.

This sand stored much impurity in the winter. Nitrification began actively in June, and for three months appeared to be active in removing stored impurity, so that purification did not approach the completeness given above till September, since which time it has steadily grown more complete.

Another sand still finer than the last, having more than 10 per cent. of very fine dust and also containing nearly 2 per cent. of organic matter (making up what is known as river silt), gives its best results in December, after filtering in one year 45,000 gallons of sewage, — the equivalent of 9,000,000 gallons on an acre, — and while filtering at the rate of 12,000 gallons per acre per day. The organic matter of the effluent in the first half of December was reduced to one-quarter of what it was previously, and became but 4 per cent. of that of the sewage; and the nitrogenous matter, as expressed by the ammonias, became 3½ per cent. of that of the sewage.

The loss on ignition was . .	1.0	parts per 100,000.
The free ammonia, ...	0.0800	" " "
The albuminoid ammonia, . .	0.0190	" " "
The nitrates, ...	0.1500	" " "

The number of bacteria in a cubic centimetre of the sewage was 1,100,000, and the number in the effluent, 7.

The ammonias of the effluent averaged, from March to August, 27 per cent. of those of the sewage, and from September to November, 11 per cent. of those of the sewage.

This material has given poor results during ten months of the year, but has greatly improved during the past month, when sewage has been applied once in two or three days and rain has been excluded from the surface.

Garden soil makes a very poor filter. Upon applying sewage intermittently to a body of garden soil five feet deep, after the first month the organic impurities increased continually for eight months, until the effluent became more impure than the applied sewage. There had then been applied 24,000 gallons, the equivalent of 4,800,000 gallons on an acre; and it was then being applied at the rate of 10,000 gallons per acre per day. The daily quantity passing through has since been reduced to 5,000 gallons per acre per day; and the quality of the effluent has somewhat improved, but still contains as much nitrogenous matter as crude sewage.

The best results are the last, and are as follows: —

Loss on ignition, ...	12.2	parts in 100,000.
Free ammonia, ...	2.9200	" " "
Albuminoid ammonia, . . .	0.2900	" " "
Nitrates, ...	0.0250	" " "

The bacteria number 109, while in the sewage they numbered 200,000.

The effluent just described has been about two months in coming down through a depth of five feet of soil. In this time sewage has been applied once in two or three days, and of late the fifty gallons applied disappears in two or three hours. This garden soil contains but little coarse material, and probably fifty per cent. of it would be called fine dust.

A mixture of coarse and fine sand and fine gravel four feet deep has filtered sewage for eleven months very satisfactorily. During the cold months of February and March, the ammonias of the effluent were twenty-five per cent. of those of the sewage. They decreased in May to five per cent., and for the past six months have been continually less than one per cent., and now are one-quarter of one per cent. of those of the sewage. In July, after 30,000 gallons of sewage had been applied, equivalent to 6,000,000 gallons upon an acre, and while applying 57,000 gallons per acre per day, the effluent had three-quarters of one per cent. as much free and albuminoid ammonia as the sewage; but this was too large a quantity of sewage to be applied daily for a long period. In August, the same result was obtained when applying at the rate of 42,000 gallons per acre per day. One quarter of one per cent. was maintained through September and October when applying 35,000 gallons per acre daily; and the same percentage continues through November and into December while applying 25,000 gallons per acre daily. The final analysis gives the following result: —

Loss on ignition, ...	0.8000	parts	in	100,000.
Free ammonia, ...	0.0000	"	"	"
Albuminoid ammonia, . . .	0.0042	"	"	"
Nitrates, ...	0.7800	"	"	"

The bacteria of the effluent numbered 14, while those of the sewage numbered 350,000.

The organic impurities of this effluent from sewage are much less than those of most of the water supplies of the State.

Another tank, having four feet in depth of material like the last, filtered sewage with nearly the same results until the first of September, when it was covered to the depth of one foot with peat from Saugus marsh, well pulverized. Upon saturating this with sewage, the quantity flowing through became only 2,800 gallons per acre per day; and, with the top of peat continually covered with sewage, the quantity flowing through has decreased in three months and a half to 1,400 gallons per acre per day; and the ammonias are nearly equal to those of the applied sewage.

Another tank has the lower four feet of like material covered with ten inches in depth of yellow sandy loam and six inches of brown soil. Comparing the results with the filter having four feet of like material without the loam and soil, we find this filter with loam and soil, with the same amount of sewage applied, stored up impurities for a longer time; but after they reached the bottom the effluent continued during the cold months very like that of the former; but this quality of the effluent continued much longer; and when nitrification began, a month later than in the former, the amount of nitrification and the consequent purification were much less. The same quantities of sewage were applied daily to each until the middle of June, when this effluent contained ten times as much ammonia as the other; and the surface of this became so choked that the quantity was reduced to about 4,000 gallons per acre. Nitrification nearly ceased; and, with this small quantity, the effluent was but little better than in the cold months when seven times as much sewage was filtered. In July no sewage was applied for twelve days; after which one-half inch in depth of the soil was removed from the surface, and the quantity was increased to 20,000 gallons per acre per day. The impurities doubled; but nitrification again commenced and they were reduced; and upon reducing the quantity applied to 15,000 gallons per acre per day, — making the application of double this quantity once in two days, — the impurities decreased rapidly; and in the beginning of October the effluent reached the condition which that of the other filter without the loam and soil attained the first of June, when twice as much sewage was filtering. During the latter part of October and through November and to the middle of December, when filtering from 10,000 to 12,000 gallons per acre per day, by applications once in two or three days, the effluent has been very nearly as pure as that from the sand and gravel without the loam and soil, where about three times as much sewage was filtered. The final analysis of effluent which is the best is as follows: —

Loss on ignition, ...	1.0000 parts in 100,000.
Free ammonia, ...	0.0008 " " "
Albuminoid ammonia, . . .	0.0052 " " "
Nitrates, ...	0.8000 " " "

The bacteria of the effluent have, during the past month, varied from none to twelve; and it may be that none came through the filter, but that the few counted came from the air while collecting the sample.

Four tanks of material from Saugus marshes, placed so as to present the conditions for a depth of five feet as nearly identical as possible with those at four places on the marshes where the depth of peat was one and a half feet, two and a half feet, three and a half feet, and five feet, have received sewage daily for six and seven months. The amount of sewage that will pass through the peat is so small that they are all worthless as filters. That in which the peat is five feet deep has had sewage upon the surface for more than six months, but none has reached the outlet. That in which the peat is three and a half feet deep has had some liquid from the sewage flowing out for more than a month, and the impurities of the effluent increased five fold. In the two tanks having a less depth of peat the sewage reached the bottom earlier, and the effluent is rapidly becoming a simpure as the sewage.

Experiments upon the filtration of city water have been continued in two tanks. One of these contained coarse and fine sand and fine gravel to a depth of four feet, overlaid with fine sandy loam one foot deep, and a surface layer eight inches deep, of the same quality as the lower section.

During the cold months of January, February and March, this material filtered city water at the rate of 50,000 gallons per acre per day, and removed three-quarters of the nitrogenous organic matter, as shown by the ammonias. The nitrates were a little less than in the water applied.

From the fifth of April, when the temperature of the effluent was 39° and the nitrates were 0.012 parts in 100,000, — the same as in the applied water, — they increased continually till June 5, when they became 0.080 parts, after which they decreased for a month to 0.025 parts; near which they have remained for six months, in which time they have been nearly the same as the nitrates of the applied water. During the month when they were highest, — from the middle of May to the middle of June, — nearly two and a half times as much

nitrogen came out of the filter in the effluent (mostly in the form of nitrates) as was applied in the city water. Some of the nitrogenous matter which had been stored in the sand during the winter was thus removed.

For the three months of April, May and June the average quantity filtered was at the rate of 35,000 gallons per acre per day; and the ammonias were 42 per cent. of those of the applied water. The quantity was then increased, and continued until the middle of November at the rate of 200,000 gallons per acre applied daily, on six days in a week, with the resulting ammonias one-quarter of those of the applied water.

From the middle of November, the quantity has been still further increased to 300,000 gallons per acre, applied daily on six days in a week, with the resulting ammonias one-third of those of the applied water. The average of the analyses for this period is as follows: —

Loss on ignition, . . .	0.6200 parts per 100,000.
Free ammonia, ...	0.0002 " " "
Albuminoid ammonia, . . .	0.0034 " " "
Nitrates, ...	0.0260 " " "

During the summer and fall all of the vegetable organisms of the city water which can be identified by the microscope were removed by this filter. Of the bacteria, about one-quarter as many as in the city water have been found in the effluent, when the largest quantity was being filtered.

To the other tank of sand five and one-half feet deep water has been applied in much larger quantities. Water covering the sand in the tank to the depth of six inches passed through at the rate of three hundred million gallons per acre per day, and it is so open that after draining a short time air can readily be blown through the whole depth of it. It is from the same pit as the sand of the first four tanks mentioned above.

For three months water was applied hourly, fourteen times a day, making a total quantity which is at the rate of four and a half million gallons per acre per day. The amount applied disappeared from the surface in about six minutes.

For two and a half months during July, August and September, the filtered water improved. The organic matter

shown by the loss on ignition and by the ammonias was about two-thirds of that of the applied water, and the color was entirely removed.

The bacteria were reduced to about one-eighth of those of the applied water, and the organisms that can be identified by the microscope were at times very much reduced; but at about the end of the time mentioned some species increased day after day and soon far exceeded the number in the applied water. Two weeks later the color of the effluent became as deep as that of the applied water, and the ammonias were nine-tenths of those of the applied water. This condition continued for a month and a half, when the quantity applied was reduced to about two million gallons per acre per day, at which rate it has since been continued. The resulting color has been about three-quarters as deep as that of the applied water; the ammonias continue at nine-tenths of those of the applied water, and the bacteria remain about the same as before; but the microscopic organisms are very much reduced.

From the results with these two tanks we conclude that the vegetable organisms which render many waters objectionable may be filtered out by intermittent filtration at the rate of 300,000 gallons per acre per day, and probably at a much higher rate; but we have not yet succeeded in removing enough of them to give a satisfactory result, when filtering at the rate of 2,000,000 gallons per acre per day.

Experiments upon rapid continuous filtration of drinking waters have been made by the Board the results, of which are stated in the report to the city of Brockton, contained in the first section of this report.

Returning to the slow filtration of the tanks receiving sewage, a very few vegetable organisms that can be identified by the microscope have been found to occasionally pass through the coarser filters; but in general none come through. A few animal forms have been found in the effluent; but these may grow in the underdrains and outlet pipe. The question remains to be settled, whether any animal or vegetable microscopic organisms live to get through the filters of finer material at the rate which sewage has been filtering.

Of the still more minute organisms, the bacteria, we found that soon after sewage was first applied to the tanks they came through in great numbers, but became reduced in number, and during the later winter and spring months amounted to two per cent. and less of those of the applied sewage; but after nitrification commenced they decreased rapidly, and continued through the summer, in many cases, less than one hundred, and in some, less than ten, while the number in the same quantity of applied sewage was about a million. This result led to the question whether any of those contained in the applied sewage during the summer came through the filters; and this question was referred for solution to Prof. Wm. T. Sedgwick, whose report will be published in the Supplement.

The experiments made under his direction to the present time show that the number of bacteria in the sand decrease very rapidly from the surface downward. In the finer sands they nearly or quite disappear before the bottom is reached. Experiments are in progress to prove whether any live to come through the finer sands with the effluent; but they have already shown that through the very coarse sands they are brought with the effluent in very small numbers, with the ordinary rate of flow from the sewage tanks, and that when the rapidity of flow is the highest, the number of bacteria in tne effluent has reached as high as two per cent. of the number in the applied sewage.

In some of the tanks it appears that, of the large number of species found in the sewage, a single species only lives to reach the outlet.

We have reason to hope that filters may be so made and managed that all disease germs may be, with certainty, removed, and think this important subject should be pursued to definite conclusions.

Recommendations.

Owing to excessive rainfall during the past two years, there are many drinking waters in the State polluted by sewage, which, being so much diluted, appear in our records as of much better quality than they will be during a dry season. The Board recommends that examinations of these

sources be continued, as well as of others which show peculiarities at different seasons of the year; also, that experiments be continued upon intermittent filtration of surface waters, to determine the conditions in which color and objectionable vegetable growths may be removed.

The Board also recommends continuance of the experiments upon the purification of sewage at Lawrence, together with experiments upon clarification of sewage by chemical precipitation.

For these purposes, and to make the necessary investigations in order to advise cities, towns, corporations and individuals in regard to the best method of assuring the purity of intended or existing water supplies, and the best method of disposing of their sewage, and to carry out the other provisions of chapter 375 of the Acts of 1888, the Board estimates that the sum of twenty-five thousand dollars will be required.

HENRY P. WALCOTT,
ELIJAH U. JONES,
JULIUS H. APPLETON,
THORNTON K. LOTHROP,
FRANK W. DRAPER,
HIRAM F. MILLS,
THEODORE C. BATES,
State Board of Health.

FOOD AND DRUG INSPECTION.

REPORT OF THE STATE BOARD OF HEALTH TO THE LEGISLATURE.

REQUIRED BY CHAPTER 289 OF THE ACTS OF 1884.

INSPECTION OF FOOD AND DRUGS.

OFFICE OF THE STATE BOARD OF HEALTH,
13 BEACON STREET, BOSTON.

Hon. H. C. HARTWELL, *President of the Senate.*

SIR: — I have the honor to present herewith to the Legislature the report of the State Board of Health, relative to the inspection of food and drugs, in compliance with the provisions of section 2 of chapter 289 of the Acts of 1884.

Respectfully, your obedient servant,

SAM'L W. ABBOTT,
Secretary of the State Board of Health.

REPORT.

The following report embraces the operations of the Board which have been conducted during the year ended Sept. 30, 1888, under the provisions of the food and drug Acts.

Under the authority of these Acts, the following analysts and inspectors, appointed by the Board, have performed the duties required of them during the year: —

Dr. EDWARD S. WOOD, ...	*Analyst.*
Dr. BENNETT F. DAVENPORT, ...	"
Dr. CHARLES HARRINGTON, ...	"
Prof. CHARLES A. GOESSMANN, ...	"
JOHN H. TERRY, ...	*Inspector.*
JOHN F. MCCAFFREY, ...	"
HORACE F. DAVIS, ...	"

Inspector McCaffrey resigned his position in April, 1888, and Horace F. Davis was appointed in June, 1888, to fill the vacancy.

The work of the year in this direction has been conducted in the same manner as in former years, under the direction of the secretary, with such modifications as the experience of the Board has suggested. A greater amount of work has been accomplished than has been done in any previous year, in consequence of improvements in all the departments of inspection.

The operations conducted under the Statutes of 1882 and 1884 include the collecting and primary inspection of all articles of food and of drugs which are liable to adulteration, together with their subsequent examination by the analysts, and finally the prosecution of offenders.

Collection of Samples.

The collection of articles of food and drugs is confined mainly to such articles as are liable to adulteration. The list of such articles varies considerably from year to year, and even from one season to another, and constant vigilance is necessary to detect them as they make their appearance. The cost of an article has a decided determining influence upon the question of its liability to adulteration, many of the staple articles of food, such as the cereals and sugar, rarely being found adulterated in our markets.

The collections are made chiefly by the inspectors, and also in the main from retailers, such samples being the best representatives of the food itself in the condition in which it finally reaches the consumer. The work of inspection also includes a careful examination of the methods in which food is offered for sale, especially with reference to the question of labelling and the agreement of the label with the actual contents of the package to which it is affixed, since the statute provides that "mixtures or compounds" are not to be treated as adulterated in the eye of the law, "provided that the same are not injurious to health and are distinctly labelled as mixtures or compounds."

This provision of the law is frequently disregarded, especially in the case of spices; and while the term "compound" is to be found after prolonged search upon the label, it usually occupies an obscure position, or is printed in extremely small type, so that the term *distinctly* labelled does not apply.

It is not safe to infer that all parts or packages in a lot of spices or similar articles of food are pure, because a single sample or package proves to be pure. The following case is an illustration: Two packages of powdered cloves were obtained at a grocery in one of the towns of Western Massachusetts during the past year. The packages were in unbroken tin boxes of one-quarter pound each, and were purchased at an interval of three weeks; each package was of the same size, and each had exactly the same brand or label. On inquiry of the retailer, it was found that both of the packages came from the same lot. It was found on

examination that the first package was considerably adulterated and the second was pure. A notice of this fact was therefore sent as usual to the retailer, who transmitted the notice to the manufacturer, who lives outside the limits of the State; he denied the charge, and hence, as is customary in cases of disputed analysis, samples were sent to a second analyst, who confirmed the statement of the first; and finally four analyses were made, neither chemist knowing anything of the source of the samples, nor did either know that a previous analysis had been made.

This circumstance shows that it is not always safe to judge of the character of any group or lot of articles from the examination of a single sample.

Gross Appearances.

It is evident that very little reliance can be placed upon the mere external inspection of articles of food, such as may be made by the employment of the senses of taste, touch, smell and sight, since the principal object of the falsifier of food preparations is to deceive the senses of the consumer by every possible resource of his art. It is a common experience in this department of the work of the Board, to receive articles of food from various sources, which are believed by the persons presenting them for examination to be adulterated, but which the analyst finds to be pure. This experience is true in the case of many of the articles of food which are liable to adulteration, and also of some articles which are scarcely ever found to be adulterated. The same experience has been met by other authorities who have had charge of similar work. (Report of Commissioner of Internal Revenue, Washington, 1887, p. cxliii. Also, Public Health Supplement. Sixth Report of Board of Health, Lunacy and Charity, p. 102.) Among the various articles which have been thus submitted to the Board for examination (under the impression of the person submitting them that they were adulterated) were the following: flour, sugar, molasses, vinegar, cream of tartar, honey, milk, butter, cheese, lard, salt, and several kinds of spices or condiments.

The reasons for these false notions with reference to the

quality of articles of food are mainly the following: 1. A liability to mistake the deterioration of an article, or an inferiority in grade or quality, for an actual falsification or substitution. 2. A lack of familiarity with the true physical characteristics of the article in question. Occasionally it happens that the person submitting an article for analysis will doubt the result of the analysis, even when two or more analysts have agreed as to its character.

The administration of the inspection work of the Board has already been described quite fully in previous reports, and it is not necessary to repeat the details of the work. (See report of 1884, pp. 98–111; and the regulations published in the eighteenth annual report, 1886, p. 323.)

At present, all samples are transmitted to the analysts of the Board, the labels or other marks indicating their source being reserved by the inspectors. The samples are then examined by the various processes which are requisite for the determination of the quality or composition of the articles under consideration. These are physical and chemical analysis, examination with the microscope, the polariscope, and the various instruments for the determination of the specific gravity of different fluids. To these are occasionally added experiments upon animals, for the determination of the effect of certain new adulterations, as they occasionally appear. These varied operations are conducted at the different laboratories, two of which are located at Boston and one at Amherst.

As soon as the analysts have determined the character of the articles submitted to them, their reports are forwarded to the secretary of the Board, who examines the report upon each sample. If it is found to be adulterated, a notice of the fact is issued to the retailer, together with a statement of his liability under the law, provided it be the first time that such article as adulterated is found to be sold by him. If the sample is obtained of a wholesaler or producer, or if the evidence is reasonably clear that the vendor is cognizant of the offence, the inspector who obtained the sample is instructed to enter a complaint at court against the offender.

Requests are often made to the Board to withdraw com-

plaints, or to receive the requisite fines at the office of the Board, the evident object being to avoid the publicity of a complaint or conviction at court; but it should be distinctly understood that offences committed within the meaning of the food Acts cannot be settled at the office of the Board, since the only place provided for by law for such settlement is at the court room.

Reports are required from the analysts, once in each month, of the work done by them during the month, such reports comprising a summary of the results obtained by them. Reports are also required monthly of the inspectors, comprising a list of the complaints entered by them during the month, with the disposal of each, together with a summary of the articles obtained by them during the month, and a list of the places from which they were obtained. These reports are transmitted to the Board.

To this work has also been added recently a printed monthly report, comprising these facts, for publication, the whole being printed on the second Saturday of each month, and issued together with the regular weekly summary of mortality returns from cities and towns for the same week. There has been a large demand for these printed statements, not only from within the limits of the State, but also from parties in neighboring States, to whom they have proved to be an advantage. It has not been practicable to supply parties outside of the State, in consequence of the limited edition.

The following summary presents the principal data relative to the number of samples of food and of drugs examined for the year ending Sept. 30, 1888, together with the number of each sort found to be adulterated, the number free from adulteration or conforming to the legal standard, and the percentage of adulteration of each class and of the whole.

Number of samples of food examined,	4,904
" " found to be pure,	3,385
" " adulterated, or not conforming to the statutes,	1,519
Percentage of adulteration,	30 9

Number of samples of milk (included above),	2,825
" " " above standard,	1,705
" " " below standard, or otherwise adulterated,	1,120
Percentage of adulteration,	39.6
Number of samples of drugs,	862
" " " of good quality,	634
" " " not conforming to the statutes,	228
Percentage of adulteration,	26.4
Total examinations of food and drugs,	5,766
" " of good quality,	4,019
" " not conforming to the statutes,	1,747
Percentage of adulteration,	30.3

A further summary is also presented, for the purpose of comparison with the work of previous years: —

SUMMARY.	Years. 1883.	1884.	1885.	1886.	1887.	1888.	Totals.
Number of samples of food examined,	695	1,962	3,771	3,438	4,870	4,904	19,640
" " " found to be pure,	363	779	2,180	2,186	3,163	3,385	12,056
" " " found to be adulterated, or not conforming to the statutes,	332	1,183	1,591	1,252	1,707	1,519	7,584
Percentage of adulteration,	47.8	60 3	40.3	36.4	35.1	30.9	38.6
Number of samples of milk examined (included above),	218	1,123	2,219	2,085	3,081	2,825	11,551
" " " above standard,	35	347	1,297	1,323	1,900	1,705	6,607
" " " below standard,	183	776	922	762	1,181	1,120	4,944
Percentage of adulteration,	83.9	69.1	41.7	36.5	38.3	39.6	42.8
Number of samples of drugs examined,	603	682	1,007	888	550	862	4,592
" " " of good quality,	357	431	571	463	400	634	2,856
" " " adulterated, as defined by the statutes,	246	251	436	425	150	228	1,736
Percentage of adulteration,	40 8	36.8	43.3	47.8	27.3	26.4	37.8
Total examinations of foods and drugs,	1,298	2,644	4,778	4,326	5,420	5,766	24,232
" " " " of good quality,	720	1,210	2,751	2,649	3,563	4,019	14,912
" " " " not conforming to the statutes,	578	1,434	2,027	1,677	1,857	1,747	9,320
Percentage of adulteration,	44.5	54.2	42 4	38.7	34.3	30.3	38.5
Expense of collection, examination and prosecution,	$2,931 56	$5,529 60	$8,557 43	$8,025 34	$8,803 62	$8,915 41	$42,762 96
" " " per sample,	2 26	2 09	1 79	1 85	1 62	1 54	1 76

Remarks upon the Foregoing Table.

It would be difficult to show, from any statistics which could be presented, what the actual amount of adulteration is throughout the State, in all articles of food or drugs which may be liable to adulteration, or what is the actual improvement or change which results from the enactment of the food laws, for the reason that many of the staple articles of food are not subject to adulteration. Again, new forms of adulteration are constantly appearing, and these differ greatly from year to year, necessitating care in the methods of inspection and collection. Legislation also varies, and the standards adopted for articles of food are occasionally changed. (The milk standard and the vinegar standard have both been changed since the enactment of the food laws.) Hence the difficulty in accurate comparison between the work of one year and that of another. Sufficient is known, however, to show that the enactment of the law has held in check many forms of adulteration; in many forms there has been very marked improvement, and certain modes of adulteration have been driven out of the State, and entirely suppressed.

Food.

The following list shows the number and the variety of the articles of food which have been collected and submitted to analysis during the year.

Allspice,	88	Canned vegetables,	7
Essence of almond,	7	Citron,	1
Baking powder,	15	Cloves,	124
Brown-bread mixture,	1	Corn starch,	1
Butter,	360	Cream cake,	1
Cassia,	132	Cream of tartar,	193
Cayenne,	23	Curry powder,	8
Candy,	19	Gelatine,	1
Celery salt,	7	Ginger,	128
Cheese,	20	Jamaica ginger,	1
Hog's-head cheese,	1	Herb dressing,	1
Chocolate,	1	Honey,	46
Desiccated cocoanut,	1	Horseradish,	2
Cocoa,	17	Jam,	1
Coffee,	2	Jelly,	4

Lard,	41	Pickles,	3
Lime juice,	2	Pimento,	9
Lemon juice,	2	Sage,	8
Mace,	51	Salad dressing,	1
Macaroni,	3	Salt,	2
Maple sugar,	22	Savoy,	3
Maple syrup,	33	Soda,	24
Marjoram,	3	Sugar,	16
Molasses,	71	Tea,	30
Mustard,	101	Thyme,	6
Nutmeg,	8	Vermicelli,	2
Olive oil,	8	Vinegar,	133
Orange marmalade,	1	Rolled wheat,	1
Pepper, black,	144	Wheat meal,	1
Pepper, white,	64		

From this list it will be seen that the principal articles of food which were collected during the year were butter, spices of different sorts, lard, molasses, maple syrup and sugar, cream of tartar, honey, cocoa, cheese, confectionery, vinegar, tea and soda.

Maple Syrup and Sugar.

During the late winter and early spring months, the adulterations of these articles have made their appearance usually in advance of the genuine article. The chief adulteration used in the preparation of maple syrup is glucose; and, while there is no evidence that this form of sugar is injurious in its character when properly prepared, it must be regarded as an adulteration when sold under the name of another article of better quality. Several parties have been convicted in the courts for such sales. The manufacture of such preparations is conducted by several parties in Boston and its immediate neighborhood.

Attractive labels are affixed to these preparations, representing them as "pure" or "strictly pure," and also claiming that they were produced among the maple groves of Vermont. It was shown, however, that their principal origin was in certain mixing-houses in and about Boston, a sufficient quantity of pure syrup being added to impart the proper flavor.

The adulteration of maple sugar is conducted largely by

other parties, the article used for adulteration being mainly some cheaper sort of sugar — often the cheapest molasses sugar — of coarser grades.

Oleomargarine.

This article of food, notwithstanding the rigid restrictions under which it must be sold, if sold at all in the State, has attained a place of considerable importance as a food product.

The two important questions, as to its healthfulness as an article of food and as to the proper regulation of its sale to prevent fraud, have already been reported upon by this Board. So far as the former question is concerned, there appears to be but one opinion among the best authorities upon food questions; that, when oleomargarine is properly made, of good and wholesome materials, it is a healthful article of food, and forms an important addition to the food supply. But, since it resembles so closely another important article of food of greater money value, it is liable to be fraudulently sold in place of butter; and hence measures are taken to prevent such sales, both by State and by national laws.

The Board has carried out the rule which has been required during the past year, devoting to oleomargarine such an amount of work as the importance of the case required, the statutes providing that three-fifths of the appropriation should be applied to the inspection of milk and milk products.

The following data relative to oleomargarine are extracted in brief from the report of the Commissioner of Internal Revenue for the fiscal year ended June 30, 1888.

	Pounds.
Oleomargarine produced in United States during the year,	34,325,527

Oleomargarine produced in Massachusetts, from Nov. 1, 1886, to June 30, 1887,	594,541
Oleomargarine produced in Massachusetts, from July 1, 1887, to June 30, 1888,	657,712
Total,	1,252,253

Revenue.

Tax on oleomargarine (Massachusetts), at two cents per pound,	$12,983 24
Special taxes, manufacturers,	600 00
Special taxes, retail dealers,	18,462 00
Special taxes, wholesale dealers,	10,280 00
Total,	$42,325 24

The tax on wholesale dealers in Massachusetts is greater than that of any other State, and that of retail dealers is exceeded only in Illinois.

The number of manufacturers of oleomargarine in Massachusetts, as returned in the report of the commissioner for 1888, was one, and of wholesale dealers, twenty-five. The number of retail dealers for 1888 was 405, as compared with 411 in the previous year.

The location of manufacturers and wholesale dealers doing business in 1888 was as follows: —

MANUFACTURERS.

Cambridge,	1

WHOLESALE DEALERS.

Boston,	12	Lawrence,	1
Fall River,	3	Salem,	1
Lowell,	3	Gloucester,	1
Worcester,	2	Springfield,	1

The number of retail dealers changes considerably from year to year and from month to month. At the date of the present report it was about 400.

The unusually large number of samples of butter and oleomargarine obtained during the year, and submitted to analysis, — 360, — was due to the legislative order of the previous year, requiring a report to be made upon the subject.

While it is quite clear that there is a much better compliance with the requirements of the statutes as to the sale of oleomargarine than was found to exist during the first years after the enactment of such laws, there is still room for further improvement in some of the minor points. The provisions of the law which are most frequently violated are

those which relate to the proper marking of packages, both wholesale and retail.

Manufacturers in neighboring States continue to send oleomargarine into Massachusetts marked with the word "Dairy" or "Creamery," in violation of the statutes of this State. Convictions have already been secured against parties selling oleomargarine thus marked in Massachusetts. Many dealers express their willingness to comply cheerfully with the law in every particular, while a few attempt evasion at every possible point.

For the purpose of marking packages and wrappers it is quite common to use the rubber stamp, instead of a distinctly printed label. These rubber stamps are liable to abuse in many ways. The labels which are printed with them are rarely plain and distinct. Frequently the important words or portions of words are omitted by careless or intentionally imperfect stamping, and in some instances it has been evident that the first distinct impressions were rejected, and only the imperfect labels were selected for use. In other cases the labels have been placed upon the inside of the package instead of the outside, or they have been concealed in folds of the paper, or obliterated and rendered illegible.

Reference has already been made to the change in popular opinion as to the question of actual harm from the consumption of oleomargarine. Upon this point, Dr Richards says, in the Annual Report of the Commissioner of Internal Revenue for 1888 (p. clxiii): "From a personal inspection of the large retail dealers in the cities visited, I am convinced that whatever prejudice may have existed, however erroneously, against oleomargarine when the law first went into effect, has now for the most part disappeared, and the article is demanded and bought on its own merits by an increasing number of consumers. Some of these stores sell from one-half to one ton per week, even in spring, when butter is cheap, in quantities of less than ten pounds to any one person at one time, put up in packages duly branded with the word 'oleomargarine,' as required by the law and regulations. Cities like Boston with nearly two hundred and Chicago with four hundred retail dealers in oleomargarine

give some idea of how extensively artificial butter is dealt in."

The protection afforded to the consumers in this State by three different sets of officers, — the internal revenue officials, the inspectors of the State Board of Health, and the local inspectors of cities, — has undoubtedly restricted the fraudulent sale of oleomargarine to very narrow limits.

Thirteen complaints were entered during the year, in which convictions were secured against all except two parties.

Baking Powders.

In the report of last year special mention was made of this class of food preparations. No class of substances employed in the preparation of food has been the subject of so much discussion as these; and this is true notwithstanding the fact that, as elements in the matter of food economy, or as nutritive constituents of the necessary food of mankind, they have absolutely no value. Their use in the preparation of food was unknown until the early part of the present century, and for ages the human race has thrived without them. Whenever bread was desired which should possess the properties of porosity and lightness of texture, in early times some sort of leaven, or yeast, was employed for the purpose.

The use of baking powders at the present day is due, undoubtedly, to several causes, prominent among which is a demand for rapid and convenient methods of preparing bread and pastry for cooking; and, also, to the stimulus of trade produced by excessive advertising. The latter may be compared with the advertising of patent medicines, thousands of which have little or no actual curative value, but depend for their sale upon the credulity of the consumer.

The class of baking powders has this difference, however, that they do undoubtedly produce certain results in the way of aeration of bread. As to any actual beneficial action, however, or nutritive value which may be claimed for them, the claim is false. Nearly all the substances employed in the preparation of baking powders, or entering into their composition, are drugs, and are used to a greater or less extent as drugs, having certain definite therapeutic action; such are cream of tartar, alum, ammonia, phosphoric acid,

tartaric acid, and bicarbonate of soda. All of these substances and some others of less importance are used in the manufacture of baking powders, and all of them are also classed as poisons in the different works on toxicology. It is in the correct interpretation of the word poison, however, that the community is often led astray by the glaring misrepresentations of rival manufacturers in their advertisements in the public press. These advertisements often assume the guise of editorial advice to the innocent consumer, such advice having a market value of its own which depends largely on the circulation of the sheet in which it is published.

Now there are other articles in daily use as food or condiments which are also classed as poisons; such are common salt, mustard, cayenne pepper and vinegar, either of which may be used in sufficient doses to produce death, and yet the moderate use of either of these substances is not considered prejudicial to health. If any rival methods of preparing either of these useful condiments were to be introduced, doubtless the public press would soon be furnished with alarming statements of great injury which must arise from their use.

At this point false teaching does harm, in misleading the community and creating a distrust. The principal fallacy consists in the want of discrimination between large and small doses of the articles already named. For example, both common salt and mustard in large doses act as poisons, and produce active vomiting. In small doses, on the contrary, neither of them is harmful. The same is also true to a certain extent of cream of tartar, alum, and other ingredients of baking powders. Another property which is common to this class of articles is that of chemical reaction, which takes place when the different ingredients of these powders are brought in contact, and also into solution in the process of preparation of bread. The resulting salts which follow this union may and often do have very different properties from those which were characteristic of the different ingredients of which such powders were originally composed. In one instance, hydrate of alumina is the resulting salt; in another, a salt quite similar to Rochelle salts; and in

another, the phosphate of alumina. It is therefore a misleading statement to call alum "a corrosive poison," or to assert the same property of cream of tartar or the acid phosphate of lime, since it is not in either of these forms that the baking powder is ingested by the consumer. For the same reason it is also manifestly wrong to state that cream of tartar or phosphate of lime are healthful. Both of these are drugs, and as such have their proper uses. Their constant, daily use is another question.

The singular claim has been made in behalf of the phosphate of lime, that it "restores the phosphates lost by the removal of the bran." It may reasonably be asked whether, in the interest of public health, as well as economy, it would not be better to retain this valuable portion of the grain in preference to the attempt to substitute for the natural constituent an artificial representative. Flour made from the whole wheat, or other grains, while it may be less pleasing to the eye and possibly to the taste, has the advantage of producing wholesome bread.

Claims are made by the makers of baking powders of purity for their own products, and also of impurity for the products of others. In whatever sense these terms may be regarded by the community at large, it should be remembered that the introduction of these articles is of comparatively recent date; that they are compounded of several ingredients; that different manufacturers employ different ingredients to attain the same object or end. No standard has ever been adopted by any government authority, so far as we can learn, for this class of preparations; hence, the use of the terms purity and impurity, as applied to them, must be considered as arbitrary, or at least merely conventional. Experiments have been undertaken with the view of settling the question as to whether the ingredients of certain baking powders were injurious to health; and, while positively harmful results have in some instances been reached by the ingestion of considerable doses of such ingredients, when taken singly, still, the question of actual injury to health on the one hand, or of freedom from harm on the other, from the use of baking powders in food, cannot be regarded as settled.

If the charge of adulteration is brought against a baking powder, under the laws of Massachusetts, the only provision which would appear to have any application is that which may be found in section 3 (b.) (7) of chapter 263 of the Acts of 1882: "If it contains any added poisonous ingredient, or any ingredient which may render it injurious to the health of a person consuming it,"—since, as has already been affirmed, this class of food preparations has no standard of purity or strength.

When it is considered that baking powders have been brought to public notice, and hence largely introduced, by the most persistent advertising, the question whether the community would not be the better if their use were entirely dispensed with has not received sufficient consideration. To apply the term *healthful* to these articles is manifestly false, since a large portion of their ingredients is of no use in the animal economy for food purposes, and the process of aeration can readily be attained by other means.

The following conclusions are the results of an inquiry made by Prof. J. W. Mallet, of the University of Virginia, upon the merits of alum baking powders.

Nearly all of the powders examined contained, as their acid ingredient, a mixture of alum and acid phosphate of lime, and all contained bicarbonate of soda as the alkaline ingredient. All of them also contained more or less starch, or crude flour.

General Summary of the Conclusions reached by Professor Mallet.

The main points which seem to be established by the experiments under discussion are, briefly stated, the following: —

(*a*) The greater part of the alum baking powders in the American market are made with alum, the acid phosphate of calcium, bicarbonate of sodium and starch.

(*b*) These powders, as found in retail trade, give off very different proportions of carbonic acid gas, and therefore require to be used in different proportion with the same quantity of flour—some of the inferior powders in largely increased amount—to produce the requisite porosity in bread.

(*c*) In these powders there is generally present an excess of the alkaline ingredient; but this excess varies in amount, and there is sometimes found, on the contrary, an excess of acid material.

(*d*) On moistening with water, these powders, even when containing an excess of alkaline material, yield small quantities of aluminum and calcium in a soluble condition.

(*e*) As a consequence of the common employment of calcium acid phosphate along with alum in the manufacture of baking powders, these, after use in bread making, leave at any rate most of their aluminum in the form of phosphate. When alum alone is used, the phosphate is replaced by hydroxide.

(*f*) The temperature to which the interior of bread is exposed in baking does not exceed 212° F.

(*g*) At the temperature of 212° F. neither the "water of combination" of aluminum hydroxide, nor the whole of the associated water of either this or the phosphate, is removed in baking bread containing these substances as residues from baking powders.

(*h*) In doses not very greatly exceeding such quantities as may be derived from bread as commonly used, aluminum hydroxide and phosphate produce, or produced in experiments upon myself, an inhibitory effect upon gastric digestion.

(*i*) This effect is probably a consequence of the fact that a part of the aluminum unites with the acid of the gastric juice and is taken up into solution, while at the same time the remainder of the aluminum hydroxide or phosphate throws down an insoluble form of organic substance, constituting the peptic ferment.

(*k*) Partial precipitation in insoluble form of some of the organic matter of food may probably also be brought about by the presence of the aluminum compounds in question.

(*l*) From the general nature of the results obtained, the conclusion may fairly be deduced, that not only alum itself, but the residues which its use in baking powder leaves in bread, cannot be viewed as harmless, but must be ranked as objectionable, and should be avoided when the object aimed at is the production of wholesome bread.

In order to form a better opinion as to the comparative effects of different baking powders, a similar line of inquiry should be pursued with regard to baking powders of other kinds, beside those prepared with alum as an ingredient. Professor Mallet's careful inquiries are entitled to thoughtful consideration, but the whole class of baking powders should receive similar investigation.

In addition to the investigations of Professor Mallet upon the subject of baking powders, reference should also be made to those which have been recently conducted by Prof.

H. B. Cornwall of New Jersey for the dairy commissioner of that State. (The dairy commissioner of New Jersey has charge of the inspection of other articles of food besides milk and milk products.)

The report was founded upon the analysis of 55 samples of 39 brands of powders, 8 of which were cream of tartar and bicarbonate of soda powders, 4 were composed of phosphate of lime and bicarbonate of soda, 20 were alum, phosphate of lime and bicarbonate of soda, 4 were alum and bicarbonate of soda, and 3 were unclassified. The samples were all obtained at retail in open market.

It was found that those powders which were offered to the public with prizes of various sorts, after the fashion of a lottery or gift enterprise, were of an inferior grade.

Professor Cornwall's report contains, in addition to his own analyses, a thorough and careful review of former authorities upon the subject, including a notice of the noted English case, known as the Norfolk baking powder trial, in which the defendant, the maker of the powder, was acquitted, the testimony of excellent English authorities upon the subject being very diverse in its character.

Reference is also made to the experiments of Prof. G. E. Patrick of Kansas University upon animals, who concludes that "a properly made alum baking powder, as used in making bread or biscuit, is perfectly harmless to the human system." In this conclusion he differs from the results obtained by Mr. Knights, the English analyst, and also by Professor Mallet.

Professor Cornwall concludes from his analyses that, "with one exception, the powders containing alum all fall below the average strength of the cream of tartar powders, and in the majority of cases they fall much below the better grades of the cream of tartar powders. In the cream of tartar and the acid phosphate of lime powders, no indications of substances likely to be injurious to health, in the quantities used, have been found."

"More evidence against the use of alum in baking powders might have been presented, but it would have been of a similar nature to that which has already been given." In the opinion of Professor Cornwall, "the presence of alum in bak-

ing powders is objectionable, since, under certain conditions, it may exert an injurious effect on the digestion. The effects may not be very marked in the case of any individual consumer, but that they can be induced to a greater or less extent seems to be well established.

"There appears to be ample ground for requiring that the makers of baking powders should publish the ingredients used in their powders, in order that the consumer, who may justly have doubts of the desirability of using certain kinds, may be protected. At present the only guarantee of an undoubtedly wholesome and efficient article appears to be the name of the brand."

In order to arrive at a just estimate of the whole question, there are certain points which are also worthy of consideration.

1. The ingredients of baking powders are not essential to the growth and repair, or, in other words, to the healthy nutrition of the human body.

2. Some of their ingredients are injurious to health when taken in large doses.

3. In the process of preparing and baking the bread, these ingredients are generally changed by decomposition to substances which are less harmful than the original ingredients.

In order that no injustice might be done to such parties as offer for sale articles of food which they do not themselves manufacture or produce, the following regulation was adopted by the Board: —

"In each case of a retailer, and of every dealer not a manufacturer or producer, the secretary may, if the party has not been previously complained of in court, issue a notice or warning of any violation of the law relative to the adulteration of food and drugs, and of the offender's liability to prosecution on a repetition of the sale."

Acting under this provision of the regulations, such notices were issued to persons retailing articles of food which were found on examination to be adulterated, in the following cities and towns: —

Amesbury,	Malden,
Amherst,	Nantucket,
Arlington,	Natick,
Attleborough,	New Bedford,
Boston,	Newburyport,
Brockton,	North Adams,
Burlington,	Northampton,
Cambridge,	Provincetown,
Chicopee,	Quincy,
Fall River,	Randolph,
Fitchburg,	Revere,
Gloucester,	Salem,
Greenfield,	Somerville,
Haverhill,	Taunton,
Holyoke,	Ware,
Hyde Park,	Westborough,
Lawrence,	Winthrop,
Lowell,	Woburn,
Lynn,	Worcester.

The articles of food found to be adulterated, and for which such notices were sent to persons in the foregoing cities and towns, were as follows: —

Allspice,	2	Lemon juice,	2
Baking powder,	1	Mace,	6
Butter,	1	Molasses,	2
Candy,	1	Mustard,	30
Cassia,	9	Maple sugar,	10
Cloves,	8	Maple syrup,	7
Cocoa,	2	Olive oil,	1
Coffee,	2	Pepper, black,	36
Cream of tartar,	17	Pepper, white,	17
Gelatin,	1	Pepper, cayenne,	5
Ginger,	2	Canned vegetables,	4
Honey,	20	Vinegar,	21
Jellies,	2		
Lard,	2	Total,	211

An examination of the foregoing table, in comparison with that which was published last year, shows that the number of samples of food, exclusive of milk, was nearly three hundred more than those which were examined in the previous year, while the number of warning notices which it was found necessary to issue was very much less. This should be taken as a decided indication of improvement, when it is considered that the class of articles examined was very nearly the same in character.

The following remarks of Dr. Richards, in the Report of the Internal Revenue Commissioner (1888), have a general application, and serve to throw considerable light upon the actual character of the common adulterants in use: —

"It seems to be a popular impression that any substance used as an adulterant of, or as a substitute for, a food product, is to be avoided as itself being injurious to health. Such impression is erroneous in nearly every case. . . . Food adulteration is carried on by manufacturers in the interest of pecuniary profit and gain, and they take pains to keep themselves well posted on the subject of cheap and harmless substitutes. . . . It would be an impossible, not to say a ridiculous, attempt to convince any court or jury that ordinary potable water was either externally or internally 'injurious to health,' yet it is probably the most common adulterant used. The watering of milk is everywhere recognized as not only a fraud but also a very grave misdemeanor, if not actually a crime. This is the food on which the whole population under one year old is fed; and when the mother cannot supply the proper nourishment for the child, she must depend for its bringing up on cow's or other milk. It is self-evident that a pint of watered milk does not contain the same amount of nourishment as the same volume of whole milk; so that a child or an invalid might actually be starved to death, if compelled to rely on the former for its sole nourishment."

Milk.

By special provision of the statutes relative to food and drug inspection, as amended by the law of 1884 (chapter 289, section 1), the Board was required to expend at least three-fifths of the food and drug appropriation in the enforcement of the laws relating to the inspection of milk and milk products. This provision has been carefully carried out during the past year.

The Board has endeavored to carry out the provisions of the statutes impartially, so far as the general population of the State is concerned, and to give to each portion of territory that amount of inspection which its circumstances required. Density of population is found to be a ruling factor

with reference to milk adulteration, — those cities and towns which are located in sparsely populated districts suffering the least from the frauds of dishonest milk dealers, and the large cities, and especially those having rapidly growing suburbs, suffering the most severely. For the past few years the city of Boston has been almost the only city which has made liberal provision for its own local protection. But within the past year or more other municipalities have shown a disposition to afford a better protection; and in one city (New Bedford) the authorities have submitted the question of the appointment of a milk inspector to the action of the civil service commission.

Special attention has been given by the Board during the past year to the fraud practised by the introduction of coloring matter into milk. The defenders of this practice have stated that it is done in obedience to the demand from the consumers. In actual practice, however, it is found that at least ninety per cent. of the samples found to be colored are below the required standard of total solids, and also usually either watered or skimmed. The practice is therefore considered to be nothing more than a method of concealing fraud, and as such it is subject to complaint against the offender at court.

The following summary comprises the results of analyses of milk obtained in the cities of eastern Massachusetts. Further details relative to a portion of these samples will also be found in the reports of the analysts of milk.

Boston.

Number of samples received,	379
above standard,	196
below standard,	173
Skimmed,	10
Colored,	1
Lowest sample (total solids),	9.34
Percentage below standard,	45.65

Lowell

Number of samples received,	150
above standard,	65
below standard,	84
Skimmed,	1
Lowest (total solids),	8.63
Percentage below standard,	56.00

Worcester.

Number of samples received,	97
above standard,	73
below standard,	21
Skimmed,	3
Colored,	2
Lowest,	10.74
Percentage below standard,	21.65

Cambridge.

Number of samples received,	254
above standard,	117
below standard,	135
Skimmed,	2
Colored,	3
Lowest,	9.56
Percentage below standard,	53.15

Fall River.

Number of samples received,	91
above standard,	65
below standard,	26
Colored,	6
Lowest,	9.58
Percentage below standard,	28.57

Lynn.

Number of samples received,	84
above standard,	39
below standard,	45
Colored,	3
Lowest,	10.50
Percentage below standard,	53.57

Lawrence.

Number of samples received,	70
above standard,	47
below standard,	22
Skimmed,	1
Lowest not skimmed,	10.41
Percentage below standard,	31.43

New Bedford.

Number of samples received,	55
above standard,	50
below standard,	5
Lowest,	11.54
Percentage below standard,	9.09

Somerville.

Number of samples received,	53
above standard,	22
below standard,	30
Colored,	1
Skimmed,	1
Lowest,	10.50
Percentage below standard,	56.60

Salem.

Number of samples received,	63
above standard,	29
below standard,	34
Lowest,	10.45
Percentage below standard,	53.97

Chelsea.

Number of samples received,	69
above standard,	43
below standard,	25
Skimmed,	1
Lowest,	9.22
Percentage below standard,	36.23

Taunton.

Number of samples received,	63
above standard,	47
below standard,	16
Lowest,	11.22
Percentage below standard,	25 39

Haverhill.

Number of samples received,	82
above standard,	57
below standard,	25
Lowest,	10.62
Percentage below standard,	30.49

Gloucester.

Number of samples received,	46
above standard,	27
below standard,	19
Lowest,	8 46
Percentage below standard,	41.30

Brockton.

Number of samples received,	47
above standard,	33
below standard,	13
Skimmed,	1
Colored,	1
Lowest,	9.97
Percentage below standard,	27.66

Newton.

Number of samples received,	70
above standard,	34
below standard,	36
Lowest,	9.93
Percentage below standard,	51.43

Malden.

Number of samples received,	36
above standard,	14
below standard,	22
Lowest,	10.40
Percentage below standard,	61.11

Fitchburg.

Number of samples received,	36
above standard,	23
below standard,	12
Skimmed,	1
Lowest,	11.04
Percentage below standard,	33.33

Waltham.

Number of samples received,	27
above standard,	16
below standard,	11
Lowest,	10.74
Percentage below standard,	40.74

Newburyport.

Number of samples received,	35
above standard,	26
below standard,	9
Lowest,	11.82
Percentage below standard,	25.71

Woburn.

Number of samples received,	20
above standard,	13
below standard,	7
Lowest,	11.72
Percentage below standard,	35.00

Quincy.

Number of samples received,	22
above standard,	15
below standard,	7
Colored,	2
Lowest,	9.48
Percentage below standard,	31.82

Summary.

	Total.	Above Standard.	Below Standard.	Percentage Below Standard.	Skimmed.	Colored.
Boston,	379	206	173	45.65	10	1
Lowell,	150	66	84	56.00	1	–
Worcester,	97	76	21	21.65	3	2
Cambridge,	254	119	135	53.15	2	3
Fall River,	91	65	26	28.57	–	6
Lynn,	84	39	45	53.57	–	3
Lawrence,	70	48	22	31.43	1	–
New Bedford,	55	50	5	9.09	–	–
Somerville,	53	23	30	56.60	1	1
Salem,	63	29	34	53.97	–	–
Chelsea,	69	44	25	36.23	1	–
Taunton,	63	47	16	25.39	–	–
Haverhill,	82	57	25	30.49	–	–
Gloucester,	46	27	19	41.30	–	–
Brockton,	47	34	13	27.66	1	1
Newton,	70	34	36	51.43	–	–
Malden,	36	14	22	61.11	–	–
Fitchburg,	36	24	12	33.33	1	–
Waltham,	27	16	11	40.74	–	–
Newburyport,	35	26	9	25.71	–	–
Quincy,	22	15	7	35.00	–	2
Woburn,	20	13	7	31.82	–	–
Milk obtained in cities of eastern Massachusetts,	1,849	1,072	777	–	21	19
Milk obtained in cities of western Massachusetts,	299	252	47	–	10	–
Milk obtained in towns of eastern Massachusetts,	666	351	315	–	11	5
Totals,	2,814	1,675	1,139	–	42	24

The following list comprises the cities and towns to which notices were sent to retail dealers found selling milk below the standard, with the number of such notices sent to each city or town: —

Amesbury,	3	Newton,	15
Beverly,	7	North Adams,	1
Boston,	48	Northampton,	1
Brockton,	7	Northborough,	1
Brookline,	6	Pittsfield,	1
Cambridge,	47	Provincetown,	2
Chelmsford,	1	Quincy,	5
Chelsea,	12	Randolph,	1
Fall River,	7	Revere,	7
Fitchburg,	2	Salem,	19
Gloucester,	3	Somerville,	11
Haverhill,	8	South Framingham,	8
Holyoke,	5	Springfield,	9
Hyde Park,	11	Stoneham,	4
Lawrence,	5	Stow,	1
Lowell,	34	Taunton,	9
Lynn,	16	Waltham,	3
Malden,	5	Ware,	1
Manchester,	1	Westborough,	3
Marlborough,	1	Westfield,	1
Middleborough,	1	Weymouth,	2
Milford,	1	Winthrop,	3
Nantasket,	2	Woburn,	3
Natick,	5	Worcester,	7
Nantucket,	1		
New Bedford,	1	Total,	359
Newburyport,	1		

The statistics relative to the inspection of milk in the cities and towns of western Massachusetts will be found at the close of this report.

The following summary comprises the results of the analysis of samples of milk obtained in the towns of eastern Massachusetts. Of the whole number, more than one hundred were obtained directly from suspected producers. Hence the unusually bad showing of some of the small farming towns is not to be taken as an index of the quality of milk furnished to consumers in such towns, but indicates that the samples of milk obtained at the dairy of one or more producers in each of such towns, and intended for sale in some neighboring city, was found to be adulterated.

Usually several samples were taken from each producer in such cases.

If these special cases were eliminated from the list, the average of the remainder would be found to present a very fair showing.

TOWNS.	Total Number of Samples.	Number above Standard	Number below Standard.	Percentage below Standard.	Skimmed.	Colored.
Amesbury,	12	9	3	25.00	-	-
Attleborough,	12	10	2	16.67	-	-
Ayer,	4	1	3	75.00	-	-
Beverly,	46	21	25	54.35	-	-
Billerica,	10	2	8	80.00	-	-
Bradford,	6	3	3	50.00	-	-
Brookline,	39	26	13	33.33	-	1
Carlisle,	3	3	-	-	-	-
Chelmsford,	7	3	4	54.14	-	-
Clinton,	9	7	2	22.22	1	-
Concord,	8	-	8	100.00	-	-
Dedham,	4	3	1	25.00	-	-
Dover,	2	-	2	100.00	-	-
Dracut,	15	12	3	20.00	-	-
Groton,	10	6	4	40.00	-	-
Hopkinton,	6	-	6	100.00	-	-
Hyde Park,	63	36	27	42.86	-	3
Lincoln,	18	1	17	94.44	-	-
Littleton,	8	-	8	100.00	-	-
Manchester,	6	2	4	66.67	-	-
Marlborough,	7	5	2	28.57	-	-
Medford,	9	4	5	55.55	-	-
Middleborough,	9	8	1	11.11	-	-
Milford,	38	31	7	18.42	1	-
Millis,	1	-	1	100.00	-	-
Nantasket,	18	11	7	38.89	-	1
Natick,	36	28	8	22.22	2	-
Nantucket,	7	6	1	14.29	-	-
Needham,	2	-	2	100.00	-	-
Northborough,	12	1	11	91.67	-	-
North Easton,	8	6	2	25.00	-	-
Provincetown,	12	4	8	66.67	-	-
Randolph,	7	3	4	57.14	-	-
Reading,	6	4	2	33.33	-	-
Revere,	24	6	18	75.00	-	-
South Framingham,	39	21	18	46.15	2	-
Stoneham,	21	5	16	76.19	-	-
Stoughton,	7	5	2	28.57	-	-
Stow,	4	1	3	75.00	-	-
Wakefield,	19	11	8	42.11	-	-
Wayland,	10	-	10	100.00	-	-
Westborough,	46	34	12	26.09	5	-
Westford,	10	1	9	90.00	-	-
Weymouth,	9	5	4	44.44	-	-
West Medway,	2	-	2	100.00	-	-
Winthrop,	15	6	9	60.00	-	-
Total,	666	351	315	47.28	11	5

Drugs.

The number of samples of drugs examined during the year was 862, which was greater than that of any previous year except one. The articles which have been submitted to examination have mostly been the drugs defined in the United States Pharmacopœia.

A series of empirical preparations were also examined by the analyst of drugs, with reference to the amount of opium contained in them, this inquiry being made in connection with the investigation ordered by the Legislature, which will be found more fully detailed in Dr. Hartwell's report upon that subject. Reference to the report of the analyst of drugs will show that the improvement which has taken place in the quality of many drugs has been maintained through the past year. The pharmacopœial wines and liquors are found to be an exception to this statement, the majority of them proving to be adulterated, although the adulterations which are commonly met with are not usually of a character which is more harmful than their chief ingredient, — the alcohol which they contain.

As an example of the improvement in the quality of the tincture of opium over that which was obtained in 1883 and 1884, when the food and drug statutes were enacted, and inquiries had at first been made as to the quality of drugs as then offered for sale, the following twelve samples, obtained in the first week of October, 1888, in several different cities and towns of the State, gave the percentages of morphine as indicated: 1.01, 1.10, 1.14, 1.15, 1.15, 1.16, 1.20, 1.20, 1.21, 1.26, 1.42, 1.56, the allowable limits defined in the Pharmacopœia being 1.20 (minimum) and 1.60 (maximum).

About the same time a dozen samples of drugs, representing six different articles, all of which were among the most important and most useful preparations, such as spirits of nitre, tincture of opium, quinine, etc., were obtained in a neighboring city, in an adjoining State, in which no statutes relative to food and drug inspection had been enacted; and four only out of the twelve proved to be of standard quality, three of the inferior samples were entirely lacking

in their most important ingredient, and one had so small a quantity as to amount to a trace only. The two samples of tincture of opium had respectively .82 and .85 of one per cent. of morphine.

The following list comprises the cities and towns to which notices were sent, warning the receivers of such notices of the fact that drugs obtained of them were found to be adulterated, together with the number issued to each place: —

Amesbury,	1	Lynn,	1
Attleborough,	1	Medford,	1
Ayer,	1	Nantucket,	1
Boston,	35	Natick,	3
Brockton,	3	New Bedford,	3
Cambridge,	4	Northborough,	1
Chicopee,	2	Salem,	3
Fitchburg,	3	Somerset,	1
Gloucester,	2	Somerville,	2
Greenfield,	4	Springfield,	3
Haverhill,	4	Taunton,	2
Holyoke,	8	Westfield,	3
Hyde Park,	3	Winthrop,	1
Lawrence,	2	Worcester,	4
Lowell,	6		

The following is a list of the articles which were found to be adulterated, or not conforming to the pharmacopœial standard, and the number of each: —

Compound spirits of ether,	20	Olive oil,	6
Spirits of nitrous ether,	4	Distilled water,	5
Sweet spirits of nitre,	4	Iron and quinine citrate,	4
Tincture of nux vomica,	2	Hydrobromic acid,	1
Laudanum,	11	Jalap,	1
Saccharated pepsin,	9	Lemon juice,	1
Potassium bitartrate,	1	Licorice,	1
Potassium iodide,	7	Solution citrate of magnesia,	1
Port wine,	12	Tincture of opium,	1
Red wine,	8	Vinegar,	1
Madeira wine,	7	Ethereal oil,	1

Prosecutions.

The whole number of prosecutions conducted during the year ending Sept. 30, 1888, was as follows: —

For sale of adulterated milk in	Boston,	. . . . .	3	cases.
" " "	Lowell,	. . . . .	3	"
" " "	Cambridge,	. . . . .	2	"
" " "	Chelsea,	. . . . .	2	"
" " "	Fall River,	. . . . .	2	"
" " "	Quincy,	. . . . .	2	"
" " "	Salem,	. . . . .	1	case.
" " "	Worcester,	. . . . .	1	"
" " "	Brockton,	. . . . .	1	"
" " "	Newton,	. . . . .	1	"
" " "	Ipswich,	. . . . .	2	cases.
" " "	Concord,	. . . . .	2	"
" " "	Revere,	. . . . .	2	"
" " "	Wayland,	. . . . .	2	"
" " "	Beverly,	. . . . .	1	case.
" " "	Lexington,	. . . . .	1	"
" " "	Bradford,	. . . . .	1	"
" " "	Brookline,	. . . . .	1	"
" " "	Groton,	. . . . .	1	"
" " "	Ayer,	. . . . .	1	"
" " "	Billerica,	. . . . .	1	"
" " "	Bolton,	. . . . .	1	"
" " "	Westford,	. . . . .	1	"
" " "	Medway,	. . . . .	1	"
" " "	Millis,	. . . . .	1	"
" " "	Hopkinton,	. . . . .	1	"
" " "	Hardwick,	. . . . .	1	"
" " "	Littleton,	. . . . .	1	"
" " "	Natick,	. . . . .	1	"
" " "	Swampscott,	. . . .	1	"
" " "	Hull,	. . . . .	1	"
Total,		. . . .	43	cases.

For sale of adulterated butter in	Chicopee,	. . . . .	4	cases.
" " "	Worcester,	. . . . .	3	"
" " "	Springfield,	. . . .	2	"
" " "	Taunton,	. . . . .	2	"
" " "	Fall River,	. . . . .	1	case.
" " "	Haverhill,	. . . . .	1	"
Total,		. . . .	13	cases.

For sale of adulterated cream of tartar in Boston,	. .	1 case.
" " maple syrup in Charlestown,	. .	3 cases.
" " " " Lawrence,	. .	2 "
" " honey in Charlestown,	. . .	1 case.
" " maple sugar, Boston,	. . .	2 cases.
Total,	. . . .	9 cases.

Summary.

Milk and milk products,	. . . .	56 cases.
Other kinds of food,	. . . .	9 "
Total,	. . . .	65 cases.

Sixty-one of the foregoing complaints resulted in conviction, and four parties were acquitted. Ten cases were placed on file, on payment of costs, and eight cases were appealed. In the greater number of appealed cases, both in this year and in the foregoing years, the cases were settled and the fines paid before the time appointed for further trial. The amount of fines paid into the treasuries of counties, cities and towns during the year, was $2,042.*

* This sum represents the amount of fines paid at the time of trial; the actual amount of fines paid is much larger, since many cases are appealed merely with the object of gaining time for payment of the fine, which is quietly made by the defendants before the appointed day for the trial in the upper courts.

Expenses of Food and Drug Inspection from Oct. 1, 1887, to Sept. 30, 1888, under the Provisions of Chapters 263 of the Acts of 1882, and 289 of the Acts of 1884, relative to Food and Drug Inspection.

	Milk and Milk Products.	*Other Articles of Food and Drugs.*
Salary of Dr. Harrington,	$800 00	-
" of Prof Goessmann,	500 00	-
" of Dr. E. S. Wood,	750 00	$750 00
" of Dr. B. F. Davenport,	750 00	750 00
" of J. H. Terry,	720 00	480 00
" of J. F. McCaffrey,	420 00	280 00
" of Horace F. Davis,	191 65	127 78
" of C. P. Worcester,	366 67	-
Bill of G. Palmer,	33 33	-
" of C. M. Ellison,	12 00	-
" of C. M. Field,	105 00	-
Legal services,	96 12	139 08
Packing boxes, bottles, corks, seals and wires for reserved samples, and incidentals,	153 69	102 46
Travelling expenses and purchase of samples,	832 57	555 05
	$5,731 03*	$3,184 37
		5,731 03
Total,		$8,915 40

SAM'L W. ABBOTT,
Secretary.

* A portion of this sum (about $375) was employed in the oleomargarine inquiry, authorized by the Legislature of 1887.

REPORT OF THE ANALYSTS OF FOOD.

PROF. EDWARD S. WOOD.

REPORT OF THE ANALYSTS OF FOOD.

PROFESSOR WOOD'S REPORT.

BOSTON, Oct. 1, 1888.

Dr. S. W. ABBOTT, *Secretary State Board of Health.*

DEAR SIR: — I have the honor to submit my annual report on the analysis of foods for the year ending Sept. 30, 1888. During the year I have received and examined 1,815 specimens. I take pleasure in noting again a marked diminution in the percentage of adulterated samples. In my last report the percentage was 29.71, which was the lowest recorded up to that time; this year it is reduced to 20.22, there being but 367 samples below standard. A very marked improvement has been seen in the average quality of vinegar, butter, molasses, cream of tartar, and spices and condiments generally.

Vinegar. — Of the 130 samples received during the year, 70, or 54 per cent., fell below either the standard of acidity or of solid matter, or of both. The percentage of adulterated samples in my last report was 61.

Above standard, 60 samples.

Number containing more than 6 per cent. acetic acid,	7
" " between 5.5 and 6.0 per cent. acetic acid,	6
" " " 5.0 and 5.5 " " "	8
" " " 4.5 and 5.0 " " "	39
Total above,	60

Below standard, 70 samples, including nine above the required acid strength, but deficient in residue: —

Number containing over 6 per cent. acid,			1
" " between 5.5 and 6.0 per cent. acid,			1
" " " 5.0 and 5.5 " "			4
" " " 4.5 and 5.0 " "			3
" " " 4.0 and 4.5 " "			34
" " " 3.5 and 4.0 " "			14
" " " 3.0 and 3.5 " "			6
" " " 2.5 and 3.0 " "			5
" " " 2.0 and 2.5 " "			1
" " " 1.5 and 2.0 " "			1
Total below,			70

Butter. — One hundred and seventy-one samples, — 21 adulterated. The diminution in percentage of adulterated samples from 22.4 last year to 12.3, is due doubtless in great part to the severe penalties of the national law, and largely also to the vigorous enforcement of our own. In the analysis the same process was employed as heretofore. This process showed that, of the 21 adulterated specimens, 4 were mixtures of butter and foreign fats, while 17 were straight oleomargarine.

Cheese. — The 9 samples which were received were all genuine.

Lard. — Of 34 specimens examined, no less than 25 were found to be adulterated with foreign fats.

Molasses. — In my last report were included 84 samples of molasses, 25 of which contained salts of tin, added glucose, or both. During the past year, out of 79 samples received, only 4 were found to be adulterated with glucose. The improvement in this article of food is shown by a reduction in the percentage of adulterated samples from 30 to 5.

Honey. — Of the 46 samples of honey, more than half were adulterated with corn glucose, 21 genuine, and 25 adulterated. Many of the latter, however, were purchased with more than a suspicion as to their true character. The following brands were represented by corn glucose: Pure Florida Honey, put up by S. J. Geer, South Boston; White

Clover Honey, S. J. Geer, South Boston; Pure Vermont Honey, W. J. Lamb, Medford; Orange Blossom Honey, F. C. Stohmeyer, New York; Pure Honey, H. D. Gloyd; Pure Honey, Dillon Brothers. One specimen, which bore no label and was almost wholly glucose syrup, contained the dead body of a honey bee, inserted, doubtless, to lend an air of genuineness.

Maple Sugar. — This substance and the syrup are very commonly adulterated, and often the imitation is so perfect that no suspicion arises from the taste. Of 17 samples of sugar, all but 4 were adulterated with glucose or brown sugar.

Maple Syrup. — Ten out of 23 samples received were adulterated very extensively with ordinary glucose syrup, or with common molasses. Among the adulterated samples which were labelled were the following brands: Pure Maple Syrup, Morristown, Vt.; Pure Rock Maple, Woodstock, Vt.; Lord & Carlisle, Medford; H. D. Gloyd.

Colored Candies, etc. — Nineteen colored candies and 4 colored sugars, used for decorating cakes, were examined for poisonous colors. In none was anything objectionable found. The use of chromates appears to have been entirely abandoned since the half dozen or more prosecutions two years ago. Eleven samples of lozenges in colored wrappers were submitted, with especial reference to the coloring material in the latter. The candy itself was in all cases good. Three of the wrappers were green and three magenta, and contained considerable arsenic. One other contained chromate of lead.

Sugar. — Thirteen samples, all genuine.

Mustard. — Ninety-seven samples included 28 which were adulterated. Most of the latter were sold in bulk. Those which were marked included the following: 199 c., Imperial Crown; 3105 c., Boston Mills; 6304 b., Hope Mills; 6306 b., Cole & Firth; 6914 b., London, Extra Strong; 8421 b., Ardenter Mustard, patent process.

Ginger. — The price of ginger root is so very low that at present little inducement is offered for its adulteration. I examined 131 samples of powdered ginger, and found but 2 adulterated. One of these (1021 c.) contained ground cracker; the other (1071c.), ground cracker and rice. Two samples of colored ginger (sold as such) contained the usual amount of turmeric. The percentage of adulterated samples of this group is for the year 1.53, against 16.42 last year.

Black Pepper. — This substance, and the next in order (white pepper), show a marked decrease in adulteration. The number of samples of black pepper examined is exactly the same as last year, — 146. The number found to be adulterated was 40, against 53 of last year. But few of the adulterated samples were marked with the manufacturer's name. They were as follows: Lyons, Delaney & Co., Pawtucket, R. I.; A. C. Fitzpatrick & Co., New York; Bacon, Stickney & Co., Albany; J. F. Nickerson & Co.; Hubbard's Strictly Pure, powdered for culinary purposes (wholesale agents, Doolittle & Smith). Most of the condemned samples contained but one adulterant, 15 contained two, and 1 contained three and little else.

White Pepper. — Sixty-nine samples, 25 adulterated with one or more substances of the usual variety. Among the latter were the following brands: Lyons, Delaney & Co., Pawtucket, R. I.; G. W. Hadley & Co.; D. Lester, Providence, R. I.; F. H. Leggett & Co., New York; W. J. Stills & Co., New York.

Cayenne. — Six out of 22 specimens were adulterated. Three were marked with the names of the manufacturers: 2363 c., Taylor & Staley, Troy, N. Y.; 7532 b., Bacon, Stickney & Co., Albany; 7944 b., F. H. Leggett, New York.

Mace. — Fifty-four samples, — 38 genuine, 16 adulterated. The adulterants were usually corn or wheat; in one instance, both. All but two of the bad samples were purchased in bulk. These were 2099 c., Bugbee & Brownell; 9070 b., W. J. Stills & Co., New York.

Cloves. — One hundred and thirty samples, all but 12 genuine. One of the 12 contained corn, wheat, allspice and dirt. Only three of the 12 were branded. They were: 1179 c , A. C. Fitzpatrick & Co., New York; 2373 c., Capitol City Mills, Tracy & Wilson, Albany; 7974 c., Bacon, Stickney & Co., Albany.

Allspice. — Ninety-five samples; 3 were adulterated with ground cracker.

Cassia. — One hundred and thirty-one samples, 13 adulterated. The following brands were represented in the latter class: Bacon, Stickney & Co., Albany; A. C. Fitzpatrick & Co., New York; Lyons, Delaney & Co, Providence, R. I.; D. Lester, Providence, R. I.

Of the last nine articles enumerated, that is, mustard, ginger, black pepper, white pepper, cayenne, mace, cloves, allspice and cassia, there were examined in all 882 specimens, of which 737, or 83.56 per cent., were genuine. In the last report these nine substances were represented by 764 samples, of which 572, or 74.87 per cent., were genuine. These figures were themselves considered a good showing, and the increase in the percentage to 83.56 was hardly to have been expected, and means much more than at first sight would appear.

Soda. — Thirty-two samples were found to be free from more than the normal amount of accidental impurity.

Cream of Tartar. — One hundred and ninety-four samples, 25 adulterated. The amount of admixture ranges from about ten per cent. to complete substitution. Two samples, sold by the manufacturers to retail dealers as pure goods, proved to consist wholly of acid phosphate and corn starch. The following were the only brands represented in the list of adulterated samples: F. H. Leggett & Co., New York; Bennett, Sloan & Co., New York; Saville, Somes & Co.; Perkins & Perkins.

Baking Powders. — Of sixteen samples examined, 10 contained alum. They were as follows: 916 c., dry yeast; 1050 c., Henkel; 1507 c. (sold in bulk); 3163 c., Great Eagle; 3169 c., Davis; 8415 b., Davis; 9220 b., Davis; 8514 b., Oriole; 8719 b., A. & P.; 9674 b. (in bulk).

Tea. — Thirty-three samples of all grades were found to be genuine.

Coffee. — Fifteen samples, 3 adulterated; 9594 b. contained considerable caramel; 345 c. (Swain, Earle & Co.) and 4621 c. (Maynard & Irwin) were made of roasted cereals.

Cocoa. — Four samples, — 2 genuine and 2 adulterated. No. 1293 c. contained arrowroot and sugar; No. 7460 b. (Rockwood & Co., N.Y.) contained considerable wheat flour.

Olive Oil. — Seven samples, with one exception, genuine (928 c., Ducro et Cie).

Canned Vegetables. — Eight samples, suspected of containing copper, were tested for that substance, which was found in five, as follows: ———, Petits Pois Verts; 8749 b., string beans, Daudicolle & Gaudin; 8751 b., pease, Daudicolle & Gaudin; 8753 b., sprouts, Daudicolle & Gaudin; 8749 b., string beans, A. Billet.

Jellies. — Seven specimens; 4 were genuine. Three, which were represented to be pineapple, currant, and catawba wine jelly, were simply cider jelly, with no apparent difference one from another.

Lemon Juice. —Three samples proved to be no more than simple solutions of citric acid. They were prepared by F. P. Adams & Co., and H. D. Gloyd.

Miscellaneous. — The following articles were all found to be of good quality: —

Citron,	1	Brown bread mixture,	1
Pickles,	3	Sage,	7
Arrowroot,	1	Savory,	3
Corn starch,	1	Marjoram,	3
Salad dressing,	1	Thyme,	6
Table salt,	2	Curry,	8
Herb dressing,	1	Nutmeg,	7
Horseradish,	2	Desiccated cocoanut,	1
Macaroni,	2	Lime juice,	2
Celery salt,	7	Essences,	9
Rolled wheat,	1	Fruit syrups,	3
Wheat meal,	1		

The following were not of good quality: Fig paste, 1. The only suggestion of fig was a small amount of seed. Gelatine, 1. This sample was quite acid in reaction.

Summary.

Nature of Samples.	Number of Genuine Samples.	Number of Adulterated Samples.	Total Number of Samples.
Vinegar,	60	70	130
Butter,	150	21	171
Cheese,	9	0	9
Lard,	9	25	34
Molasses,	75	4	79
Honey,	21	25	46
Maple sugar,	4	13	17
Maple syrup,	13	10	23
Colored candies, etc.,	34	0	34
Sugar,	13	0	13
Mustard,	69	28	97
Ginger,	129	2	131
Black pepper,	106	40	146
White pepper,	44	25	69
Cayenne,	16	6	22
Mace,	38	16	54
Cloves,	118	12	130
Allspice,	92	3	95
Cassia,	118	13	131
Soda,	22	0	22
Cream of tartar,	169	25	194
Baking powders,	6	10*	16
Tea,	33	0	33
Coffee,	12	3	15
Cocoa,	2	2	4
Olive oil,	6	1	7
Canned vegetables,	3	5	8
Jellies,	4	3	7
Lemon juice,	0	3	3
Pickles,	3	0	3

* Containing alum.

Summary — Concluded.

Nature of Samples.	Number of Genuine Samples.	Number of Adulterated Samples.	Total Number of Samples.
Celery salt,	7	0	7
Sage,	7	0	7
Savory,	3	0	3
Marjoram,	3	0	3
Thyme,	6	0	6
Curry,	8	0	8
Nutmeg,	7	0	7
Essences,	9	0	9
Fruit syrups,	3	0	3
Citron,	1	0	1
Arrowroot,	1	0	1
Corn starch,	1	0	1
Salad dressing,	1	0	1
Herb dressing,	1	0	1
Table salt,	2	0	2
Horseradish,	2	0	2
Macaroni,	2	0	2
Rolled wheat,	1	0	1
Wheat meal,	1	0	1
Brown bread mixture,	1	0	1
Desiccated cocoanut,	1	0	1
Lime juice,	2	0	2
Gelatine,	0	1	1
Fig paste,	0	1	1
Total,	1,448	367	1,815

Respectfully submitted,

EDWARD S. WOOD.

DR. DAVENPORT'S REPORT.

FOOD.

BOSTON, Oct. 1, 1888.

S. W. ABBOTT, M.D., *Secretary State Board of Health.*

SIR: — I have the following report to make upon the 264 samples of food which were submitted to me for examination during the past twelve months. Of these, 32, or 12.1 per cent., were found not to be of the standard quality required by the statutes. Among them were 164 samples of butter, of which 11 proved to be oleomargarine. As stated in my last report, I have not found any admixtures of oleomargarine and butter since the passage of the national law relating to butter substitutes. Much original investigation as to the best methods for butter analysis has been carried on during the last year, the most important of which has been published in Bulletin No. 19 of the Chemical Division of the United States Department of Agriculture, and in the "Milch Zeitung."

Eleven samples of cheese were examined, and in no case was any foreign fat or improper substance found. In several cases they were from a very closely skimmed milk.

Of lards eight samples were examined, and in three of them a certain amount of cotton-seed oil and beef stearine was found to be present.

Of molasses two samples were examined, and neither was found to contain any foreign substance.

Of maple syrup eight samples were examined, and three of them were found to contain a large amount of glucose.

Of confectionery the three samples examined were all found to be free from any foreign injurious ingredient. Fig

confections, such as have been sold upon the streets of this city during the past year, were found to be a paste of harmless character, containing a few fig or similar seeds.

Coffee in two cases, and condensed milk in one case, were all found to be what they claimed.

Two samples of so-called unfermented California orange wine were, upon examination, found to be in no wise the product of the juice of any kind of orange, but from the analysis and indication of the label it would appear that the article was made in Cincinnati. They were, in short, syrups which had been colored and flavored to more or less remotely resemble orange, and preserved by salicylic acid.

Respectfully submitted,

BENNETT F. DAVENPORT.

DR. HARRINGTON'S REPORT.

BOSTON, MASS., Oct. 1, 1888.

Dr. S. W. ABBOTT, *Secretary*, 13 Beacon St., Boston.

DEAR SIR: — I have the honor to submit the following report of my work in the analysis of milk during the year ending September 30: —

I received 1,566 samples, which were collected in twenty-two cities and seventeen towns, and from twenty-nine dairies, where adulteration was suspected of being practised. The total number which failed to conform to the requirements of the statutes was 751, or 47.96 per cent. of the whole number received. The majority of these samples — that is to say, 56.06 per cent. of them — contained between 12 and 13 per cent. of total solids, thus indicating a not very extensive sophistication. The very worst samples of the year were those collected from suspected dairies.

The number of samples collected in twenty-two cities was 1,184. Of this number, 640, or 54.05 per cent., were up to the standard, and 544, or 45.95 per cent., were below it.

As was the case in the preceding report, the two poorest showings among the cities are made by Lynn and Somerville.

Boston, .	. Number received, 65.	
	" above standard, 33, . .	(50.77 per cent.)
	" below standard, 32, . .	(49.23 per cent.)
Brockton,	. Number received, 35.	
	" above standard, 23, . .	(65.71 per cent.)
	" below standard, 12, . .	(34.29 per cent.)
Cambridge,	. Number received, 262.	
	" above standard, 126, . .	(48.09 per cent.)
	" below standard, 136, . .	(51.91 per cent.)
Chelsea,	. Number received, 67.	
	" above standard, 43, . .	(64.18 per cent.)
	" below standard, 24, . .	(35.82 per cent.)

Fall River,	Number received, 28.	
	" above standard, 20,	(71.43 per cent.)
	" below standard, 8,	(28.57 per cent.)
Fitchburg,	Number received, 11.	
	" above standard, 10,	(90.91 per cent.)
	" below standard, 1,	(9.09 per cent.)
Gloucester,	Number received, 46.	
	" above standard, 28,	(60.87 per cent.)
	" below standard, 18,	(39.13 per cent.)
Haverhill,	Number received, 81.	
	" above standard, 56,	(69.14 per cent.)
	" below standard, 25,	(30.86 per cent.)
Lawrence,	Number received, 69.	
	" above standard, 46,	(66.67 per cent.)
	" below standard, 23,	(33.33 per cent.)
Lowell,	Number received, 138.	
	" above standard, 62,	(44.93 per cent.)
	" below standard, 76,	(55.07 per cent.)
Lynn,	Number received, 43.	
	" above standard, 15,	(34.88 per cent.)
	" below standard, 28,	(65.12 per cent.)
Malden,	Number received, 35.	
	" above standard, 14,	(40.00 per cent.)
	" below standard, 21,	(60.00 per cent.)
New Bedford,	Number received, 16.	
	" above standard, 13,	(81.25 per cent.)
	" below standard, 3,	(18.75 per cent.)
Newburyport,	Number received, 35.	
	" above standard, 26,	(74.29 per cent.)
	" below standard, 9,	(25.71 per cent.)
Newton,	Number received, 68.	
	" above standard, 33,	(48.53 per cent.)
	" below standard, 35,	(51.47 per cent.)
Quincy,	Number received, 9.	
	" above standard, 4,	(44.44 per cent.)
	" below standard, 5,	(55.56 per cent.)
Salem,	Number received, 74.	
	" above standard, 33,	(44.59 per cent.)
	" below standard, 41,	(55.41 per cent.)

Somerville, . Number received, 32.
" above standard, 9, . . (28.12 per cent.)
" below standard, 23, . . (71.88 per cent.)

Taunton, . Number received, 11.
" above standard, 8, . . (72.73 per cent.)
" below standard, 3, . . (27.27 per cent.)

Waltham, . Number received, 28.
" above standard, 16, . . (57.14 per cent.)
" below standard, 12, . . (42.86 per cent.)

Woburn, . Number received, 19.
" above standard, 13, . . (68.42 per cent.)
" below standard, 6, . . (31.58 per cent.)

Worcester, . Number received, 12,
" above standard, 9, . . (75.00 per cent.)
" below standard, 3, . . (25.00 per cent.)

Total of 22 Cities.

Number received, 1,184.
" above standard, 640, ... (54.05 per cent.)
" below standard, 544, ... (45.95 per cent.)

Two hundred and sixty samples were received from seventeen towns; 154 were above and 106 below the standard.

TOWN.	Number Above Standard.	Number Below Standard.	Total Number.	Percentage Good Samples.	Percentage Poor Samples.
Amesbury, ...	9	3	12	75.00	25.00
Beverly, ...	14	14	28	50.00	50.00
Bradford, ...	3	4	7	42.86	57.14
Brookline, ...	9	7	16	56.25	43.75
Framingham, ...	21	19	40	52.50	47.50
Hyde Park, ...	9	3	12	75.00	25.00
Manchester, ...	2	4	6	33.33	66.67
Marlborough, ...	8	3	11	72.73	27.27
Medford, ...	4	5	9	44.44	55.56
Middleborough, ...	8	1	9	88.89	11.11
Milford, ...	9	1	10	90.00	10.00
Nantucket, ...	5	2	7	71.43	28.57
Natick, ...	29	6	35	82.85	17.15
Provincetown, ...	4	8	12	33.33	66.67
Reading, ...	4	2	6	66.67	33.33
Stoneham, ...	5	16	21	23.81	76.19
Wakefield, ...	11	8	19	57.90	42.10
Total, ...	154	106	260	59.23	40.77

One hundred and twenty-two samples were taken from twenty-nine dairies, since the proprietors were suspected of adding water to their milk before delivery to the collectors of the milk contractors. That the suspicions were well grounded may be inferred from the following figures : —

Number of samples above standard, ...	21
" " below "	101
" containing over 14 per cent. total solids, . .	6
" " between 13 and 14 per cent., . .	15
" " " 12 and 13 " . .	40
" " " 11 and 12 " . .	26
" " " 10 and 11 " . .	15
" " " 9 and 10 " . .	6
" " " 8 and 9 " . .	6
" " " 7 and 8 " . .	8

Eleven of the twenty-one samples above the standard came from one farm in Dracut; four of the remainder were from another in Beverly, thus leaving only six as a total for twenty-seven farms located in Ayer, Billerica, Bolton, Concord, Groton, Hopkinton, Lincoln, Littleton, Medway, Millis, Northborough, Stow, Wayland and Westford.

TOWN.	Number Farms Visited.	Samples Taken.	Number over 14 per cent.	Between 13 and 14 per cent.	Between 12 and 13 per cent.	Between 11 and 12 per cent.	Between 10 and 11 per cent.	Between 9 and 10 per cent.	Between 8 and 9 per cent.	Between 7 and 8 per cent.
Ayer, ...	1	3	–	–	–	3	–	–	–	–
Beverly, ...	1	8	2	2	4	–	–	–	–	–
Billerica, ...	1	10	1	1	5	1	2	–	–	–
Bolton, ...	1	4	–	–	–	–	–	–	–	4
Concord, ...	1	8	–	–	–	5	3	–	–	–
Dracut, ...	1	14	3	8	3	–	–	–	–	–
Groton, ...	1	3	–	–	–	3	–	–	–	–
Hopkinton, . . .	2	6	–	–	3	2	1	–	–	–
Lincoln, ...	8	18	–	1	11	–	–	2	3	1
Littleton, ...	2	8	–	–	1	1	1	–	2	3
Medway, ...	1	3	–	–	–	2	1	–	–	–
Millis, ...	1	2	–	–	–	1	1	–	–	–
Northborough, . .	2	11	–	1	6	3	1	–	–	–
Stow, ...	1	4	–	–	2	2	–	–	–	–
Wayland, ...	3	10	–	1	4	3	2	–	–	–
Westford, ...	2	10	–	1	1	–	3	4	1	–
Total, . . .	29	122	6	15	40	26	15	6	6	8

CITY OR TOWN.	Number Received.	Above Standard.	Below Standard.	Above 14 per cent.	Between 13 and 14 per cent.	Between 12 and 13 per cent. (May and June).	Skimmed Milk of good quality.	Between 12 and 13 per cent.	Between 11 and 12 per cent.	Between 10 and 11 per cent.	Between 9 and 10 per cent.	Between 8 and 9 per cent.	Between 7 and 8 per cent.	Percentage of Samples above Standard.	Percentage of Samples below Standard.
Boston,	65	33	32	10	17	6	–	22	5	5	–	–	–	50.77	49.23
Brockton,	35	23	12	6	16	–	1	5	3	3	1	–	–	65.71	34.29
Cambridge,	262	126	136	24	67	31	4	85	41	8	2	–	–	48.09	51.91
Chelsea,	67	43	24	10	21	11	1	12	10	1	1	–	–	64.18	35.82
Fall River,	28	20	8	9	5	6	–	8	–	–	–	–	–	71.43	28.57
Fitchburg,	11	10	1	2	6	2	–	–	1	–	–	–	–	90.91	9.09
Gloucester,	46	28	18	7	21	–	–	15	1	1	–	1	–	60.87	39.13
Haverhill,	81	56	25	16	23	17	–	17	6	2	–	–	–	69.14	30.86
Lawrence,	69	46	23	16	24	5	1	16	3	4	–	–	–	66.67	33.33
Lowell,	138	62	76	11	44	6	1	39	19	9	7	2	–	44.93	55.07
Lynn,	43	15	28	5	10	–	–	17	6	5	–	–	–	34.88	65.12
Malden,	35	14	21	–	14	–	–	16	4	1	–	–	–	40.00	60.00
New Bedford,	16	13	3	6	7	–	–	3	–	–	–	–	–	81.25	18.75
Newburyport,	35	26	9	7	13	6	–	8	1	–	–	–	–	74.29	25.71
Newton,	68	33	35	11	22	–	–	20	9	5	1	–	–	48.53	51.47
Quincy,	9	4	5	2	–	2	–	–	2	2	1	–	–	44.44	55.56
Salem,	74	33	41	5	19	9	–	18	19	4	–	–	–	44.59	55.41
Somerville,	32	9	23	4	5	–	–	15	7	1	–	–	–	28.12	71.88
Taunton,	11	8	3	2	5	1	–	1	2	–	–	–	–	72.73	27.27
Waltham,	28	16	12	2	8	6	–	8	1	3	–	–	–	57.14	42.86
Woburn,	19	13	6	3	6	4	–	3	3	–	–	–	–	68.42	31.58
Worcester,	12	9	3	1	3	5	–	–	3	–	–	–	–	75.00	25.00
Amesbury,	12	9	3	1	2	6	–	–	3	–	–	–	–	75.00	25.00

CITY OR TOWN.	Number Received.	Above Standard.	Below Standard.	Above 14 per cent.	Between 13 and 14 per cent.	Between 12 and 13 per cent. (May and June).	Skimmed Milk of good quality.	Between 12 and 13 per cent.	Between 11 and 12 per cent.	Between 10 and 11 per cent.	Between 9 and 10 per cent.	Between 8 and 9 per cent.	Between 7 and 8 per cent.	Percentage of Samples above Standard.	Percentage of Samples below Standard.
Beverly,	28	14	14	3	9	2	–	5	5	4	–	–	–	50.00	50.00
Bradford,	7	3	4	–	3	–	–	2	2	–	–	–	–	42.86	57.14
Brookline,	16	9	7	–	7	2	–	–	5	2	–	–	–	56.25	43.75
Framingham,	40	21	19	5	14	–	2	10	8	1	–	–	–	52.50	47.50
Hyde Park,	12	9	3	1	4	4	–	–	3	–	–	–	–	75.00	25.00
Manchester,	6	2	4	–	2	–	–	3	1	–	–	–	–	33.33	66.67
Marlborough,	11	8	3	1	7	–	–	2	1	–	–	–	–	72.73	27.27
Medford,	9	4	5	2	2	–	–	5	–	–	–	–	–	44.44	55.56
Middleborough,	9	8	1	5	3	–	–	–	1	–	–	–	–	88.89	11.11
Milford,	10	9	1	5	4	–	–	1	–	–	–	–	–	90.00	10.00
Nantucket,	7	5	2	–	5	–	–	1	1	–	–	–	–	71.43	28.57
Natick,	35	29	6	9	13	4	3	2	4	–	–	–	–	82.85	17.15
Provincetown,	12	4	8	1	3	–	–	6	–	2	–	–	–	33.33	66.67
Reading,	6	4	2	1	3	–	–	2	–	–	–	–	–	66.67	33.33
Stoneham,	21	5	16	–	5	–	–	9	5	2	–	–	–	23.81	76.19
Wakefield,	19	11	8	1	10	–	–	5	3	–	–	–	–	57.90	42.10
Suspected dairies,	122	21	101	6	15	–	–	40	26	15	6	6	8	17.21	82.79
Total,	1,566	815	751	200	467	135	13	421	214	80	19	9	8	52.04	47.96

Respectfully submitted,

CHARLES HARRINGTON, M.D.

DR. DAVENPORT'S REPORT.

MILK.

BOSTON, Oct. 1, 1888.

S. W. ABBOTT, M.D., *Secretary State Board of Health.*

SIR: — I have the following report to make upon the 960 samples of milk which were submitted to me for examination during the past twelve months. Of these, 322, or 33.5 per cent. of the samples, were found to be not fairly of the good standard quality required by the milk statute.

Out of this 33.5 per cent. two per cent. had been artificially colored, principally by the use of annotto. Less than five per cent., from the results of my analyses, were judged to have naturally fallen below the required minimum limit of milk solids. They had been very largely collected from such sources as were suspected to be specially liable, and, therefore, it is not by any means to be supposed that any such large proportion of the entire quantity of milk sold throughout the State as 33.5 per cent. is in like manner debased.

The following table contains the results of my analyses of these 960 samples of milk: —

30 or 3.1	per cent.	contained	over 16	per cent.	of total	milk solids.
30 or 3.1	"	"	15 to 16	"	"	"
112 or 11.7	"	"	14 to 15	"	"	"
357 or 37.2	"	"	13 to 14	"	"	"
300 or 31.3	"	"	12 to 13	"	"	"
88 or 9.2	"	"	11 to 12	"	"	"
31 or 3.2	"	"	10 to 11	"	"	"
12 or 1.3	"	"	9 to 10	"	"	"

Of those which fell below 13 per cent. of total milk solids,

18 were sold as skimmed milk, and were of proper quality for such a milk.

The results given in the above table indicate an improvement of about 10 per cent. upon the percentage of my last annual report.

Respectfully submitted,

BENNETT F. DAVENPORT.

PROFESSOR GOESSMANN'S REPORT.

WESTERN MASSACHUSETTS.

The milk obtained in the cities and towns of the four western counties of the State, as usual, presents a much better showing than that which is furnished to the consumer in the more populous communities of the eastern counties. The percentage of samples found to be below the legal standard was, however, greater than that of the previous year; and, for the first time since the enactment of the present laws relative to food inspection, it has become necessary to enter a complaint for milk adulteration west of the Connecticut River.

The following report comprises the summary of the results of analyses of milk obtained in the cities and towns of western Massachusetts for the year ending Sept. 30, 1888 : —

The whole number of samples examined was,	299
Number above standard,	252
Number below standard,	47
Percentage below standard,	15.72
Skimmed,	10

The statistics of the cities are as follows : —

Springfield.

Number of samples,	75
Number above standard,	62
Number below standard,	13
Percentage below standard,	17.33
Skimmed,	5

Holyoke.

Number of samples,	74
Number above standard,	65
Number below standard,	9
Percentage below standard,	12.16
Skimmed,	1

Northampton.

Number of samples,	30
Number above standard,	24
Number below standard,	6
Percentage below standard,	20.00
Skimmed,	1

The results in the towns were as follows: —

	Total.	Above Standard.	Below Standard.	Percentage below Standard.	Skimmed.
Amherst,	1	1	–	–	–
Chicopee,	24	23	1	4.16	–
North Adams,	16	15	1	6.25	1
Greenfield,	34	29	5	14.71	2
Pittsfield,	12	7	5	41.66	–
Ware,	24	19	5	20.83	–
Westfield,	9	7	2	22.22	–

C. A. GOESSMANN.

REPORT OF THE ANALYST OF DRUGS.

REPORT OF THE ANALYST OF DRUGS.

BOSTON, Oct. 1, 1888.

S. W. ABBOTT, M.D., *Secretary State Board of Health.*

SIR: — I have the following report to make upon the 862 samples of drugs which were submitted to me for examination during the past twelve months. Of these, 228, or 26.4 per cent., were found not to be of their proper quality, as required by the statutes. This is an improvement upon my last year's report, which was itself an improvement upon that of the preceding year. As before stated in these reports, these percentages, however, indicate only the proportion of poor samples actually found among the suspected articles collected, and do not apply to all the articles sold in the drug trade generally.

Among the drugs examined were 50 samples of opium.

Of these,	1	yielded	over 16.0	per cent.	morphine	by the	U. S. P.	assay.
"	0	"	15.0 to 16.0	"	"	"	"	"
"	5	"	14.5 to 15.0	"	"	"	"	"
"	4	"	14.0 to 14.5	"	"	"	"	"
"	7	"	13.5 to 14.0	"	"	"	"	"
"	6	"	13.0 to 13.5	"	"	"	"	"
"	12	"	12.5 to 13.0	"	"	"	"	"
"	7	"	12.0 to 12.5	"	"	"	"	"
"	3	"	11.5 to 12.0	"	"	"	"	"
"	3	"	11.0 to 11.5	"	"	"	"	"
"	1	"	10.5 to 11.0	"	"	"	"	"
"	1	"	10.0 to 10.5	"	"	"	"	"
"	0	"	below 10.0	"	"	"	"	"

All those which yielded less than twelve per cent. of morphine were samples of gum, while the others were of powdered opium.

Of tinctures of opium, 30 samples were examined.

Of these,	1	yielded	over 1.5	per cent.	morphine	by the	U. S. P.	assay.
"	2	"	1.4 to 1.5	"	"	"	"	"
"	6	"	1.3 to 1.4	"	"	"	"	"
"	10	"	1.2 to 1.3	"	"	"	"	"
"	9	"	1.1 to 1.2	"	"	"	"	"
"	8	"	1.0 to 1.1	"	"	"	"	"
"	1	"	0.9 to 1.0	"	"	"	"	"
"	1	"	0.8 to 0.9	"	"	"	"	"
"	1	"	0.7 to 0.8	"	"	"	"	"
"	0	"	0.6 to 0.7	"	"	"	"	"
"	1	"	0.5 to 0.6	"	"	"	"	"
"	0	"	below 0.5	"	"	"	"	"

Of powder of ipecac and opium, the 19 samples examined were all found to be of standard quality. Of 24 samples of cinchona alkaloidal salts, quinine and the three others, all were found to pass the tests of the Pharmacopœia. Of citrate of iron and quinine, of the 40 samples examined, —

9	yielded over	13.0	per cent.	of alkaloid.
12	"	12.5 to 13.0	"	"
9	"	12.0 to 12.5	"	"
8	"	11.5 to 12.0	"	"
3	"	11.0 to 11.5	"	"
1	"	10.5 to 11.0	"	"
0	"	10.0 to 10.5	"	"
2	"	below 10.0	"	"

Of the 15 samples of tincture of nux vomica examined, —

1	yielded over	5.0	per cent.	of extract.
0	"	3.5 to 5.0	"	"
1	"	3.0 to 3.5	"	"
3	"	2.5 to 3.0	"	"
6	"	2.0 to 2.5	"	"
1	"	1.5 to 2.0	"	"
1	"	1.0 to 1.5	"	"
2	"	below 1.0	"	"

Of the 12 samples of powdered jalap examined, —

1	yielded over	15	per cent.	of standard	resin.
0	"	14 to 15	"	"	"
4	"	13 to 14	"	"	"
4	"	12 to 13	"	"	"
2	"	11 to 12	"	"	"
0	"	10 to 11	"	"	"
1	"	9 to 10	"	"	"
0	"	below 9	"	"	"

Of the 21 samples of spirits of nitrous ether examined, —

3	yielded	3.5 to 4.0	per cent.	of	ethyl nitrite.
1	"	3.0 to 3.5	"	"	"
1	"	2.5 to 3.0	"	"	"
0	"	2.0 to 2.5	"	"	"
2	"	1.5 to 2.0	"	"	"
4	"	1.0 to 1.5	"	"	"
7	"	0.5 to 1.0	"	"	"
3	"	below 0.5	"	"	"

Of the 20 samples of compound spirits of ether examined, but 9 contained any ethereal oil, its most important ingredient. The one sample of ethereal oil examined was found to be the light instead of the heavy oil, as it should have been. Of the 22 samples of alcohol examined, all were found to be of standard quality. Of the 23 samples of distilled spirits, brandy and whiskey examined, but 12 were found to be of fair standard quality, and not one of these was a brandy.

In a previous report I have stated that it had not yet been fairly demonstrated that the ordinary manufactured liquors were any more injurious to the health of the consumers than the natural product. In this connection a paper read by M. Laborde before the French Academy of Medicine, and reported in a late number of the "Union Médicale," is of interest. His subject was the poisonous action of alcoholic liquors, especially the factitious, with conclusions founded largely upon laboratory experiments with the flavoring essences and bouquets used in the trade. He paid particular attention to an "Essence de Noyau," a compound containing in each pint ninety grains of a "bouquet" consisting of benzo nitrile and benzoic aldehyde. This "bouquet," whether taken internally or merely inhaled, produced alarmingly deleterious effects. Among the substances used in the trade he classes the non-convulsivant substances as follows: 1. Those that may prove fatal, such as cinnamic aldehyde, cinnamate of ethyl, and the flavoring essences (essences-bouquets) of Irish whiskey, London gin, Holland gin, cherry brandy, Dutch bitters, and kirsch. 2. Those that are not usually fatal, including the benzoates of amyle and of methyl, acetate of amyl, the butyrates of

ethyl and amyl, the succinates of ethyl and of methyl, the malate, the valerianate, and the œnanthylate of ethyl, malate of methyl, acetal, methylal, amyltartaric acid, etc. 3. Those that are almost harmless, such as the flavoring essences of rum, cassia, cognac, brandy, curaçoa, kümmel, maraschino, benedictine, Paris anisette, grenadine, etc. The ill-rectified alcoholic spirit used in the manufacture of such liquors he thought was specially injurious, even if certain flavoring essences, those of rum, brandy, etc., were almost harmless. It is manifest, from his investigations, that all such products should be avoided by those having a due regard for their health.

Of the 53 samples of red and white wines examined, only 7 were of the standard quality required; that is, "fermented, unmodified juice of the grape." All the rest gave evidence of being the product of the skill of "rectifiers," so called.

With the large quantities of oranges produced in some of our States which cannot be profitably marketed as fruit, the manufacture of wine would seem to offer a satisfactory solution for their being economized. A more nearly natural wine could thus be obtained for pharmaceutical purposes than now seems to be common in my experience.

Of chloroform and ether, 5 samples were all of good standard quality, likewise 2 of iodoform and 17 of chloral hydrate. Of the fixed and essential oils, 135 samples were examined, and only 13 found not to be of fair standard quality. Of menthol, 20 samples were all found to be of the proper quality, likewise 9 bismuth salts, 23 samples of the more common powdered drugs, 11 glycerine, 10 honey, 2 licorice, 1 each of syrup, hydrobromic acid, lemon juice and musk, 2 each of aloes, benzoic acid and Epsom salts, and 4 of tannic acid. Of saccharated pepsin, 18 samples had 12 which were not nearly of the proper activity. Of saccharated carbonate of iron, 4 samples, all but one were of good quality. Of 13 samples of potassium iodide, 11 had an excess of chloride present. Of 49 samples of potassium bitartrate, 2 were not the true salt; the one being an acid phosphate of lime mixed with starch, and the other had 60 per cent. of gypsum. Of 61 samples of powdered spices, but 4 contained foreign admixture.

A sample of Colden's Liquid Beef Tonic, which is advertised as being "superior to all other preparations in the treatment of the alcohol and opium habits," was found upon assay to contain 26.5 per cent. by volume of alcohol, and to be thus stronger than the strongest natural wine.

Samples of Harriet Hubbard Ayer's Recamier Cream, Balm and Lotion were examined, and all found to contain mercury, probably in the form of corrosive sublimate. Her so-called Vita Nuova was found to be an ordinary strongly fortified wine, containing a considerable quantity of the alkaloid cocaine. This alkaloid acts as a nerve stimulant, and is derived from coca, the habitual use of which, according to the U. S. Dispensatory, "is said readily to grow upon the person, and finally the inveterate excessive coca-chewer can be recognized by his uncertain step, general apathy, sunken eyes, surrounded by deep purple areolas, his trembling lips, green and crusted teeth, and excessively fetid breath, with peculiar blackness about the corners of the mouth. An incurable insomnia is apt to be developed, emaciation becomes extreme, dropsy appears, and even death results in a condition of general marasmus."

A proprietary preparation, labelled "Whiskol, a non-intoxicating stimulant, possessing all the invigorating and sustaining properties of alcohol, without its deleterious effects. It is a whiskey without its sting; a cure for drunkenness, for it removes that craving thirst for drink that men find it so difficult to resist. H. K. Packard, Inventor, London," — was, upon examination, found to contain 28.2 per cent. by volume of alcohol. Yet this preparation has been very extensively advertised in the daily papers of this vicinity.

Samples of the Seven Sutherland Sisters' Hair and Scalp Cleaner, also their Hair Grower, have been examined. The "Cleaner" appeared to be simply a mixture of powdered borax and soap, and the "Grower" a diluted mixture of bay rum and possibly some hamamelis and Spanish flies.

Respectfully submitted,

BENNETT F. DAVENPORT.

TRICHINÆ IN SWINE.

By Prof. E. L. MARK of Harvard University.

TRICHINÆ IN SWINE.

By Professor E. L. MARK, of Harvard University

I began my examination of the hogs killed in the vicinity of Boston in the autumn of 1881. It was then thought that it might prove to be desirable to carry on investigations which could be better conducted at Chicago than in this vicinity. My first examinations were, therefore, confined mostly to so-called Chicago hogs; *i. e.*, such as were collected west of Chicago, and shipped to slaughterers from that point. But toward the end of the examinations made in that year, and not included in the five hundred reported upon, there was one small lot of hogs raised near Boston which contained two trichinous individuals. That circumstance suggested the possibility that the source of trichinæ among American hogs might possibly be sought to advantage here, instead of going to the West. The matter remained, however, without anything further being done by way of examinations until 1883-84, when a renewed interest in the subject was awakened.

When examinations were resumed in 1884, it was upon a somewhat different plan from that pursued at first. It seemed improbable that success could be attained by any other means than a careful study of all the conditions under which the hogs were raised. I had found that it would be practically impossible to trace back the history of hogs shipped from Chicago and other Western cities, because they were generally collected over extensive territories, and no record was kept of their origin. It therefore seemed best to limit examinations to animals which were *raised* in this immediate vicinity. The conditions under which they were reared

could certainly be more readily inquired into than in the case of Western hogs. The principal difficulty in the way of this plan was the limited number which one was likely to get for examination. It was also thought best to continue the examination for a number of years, so that the results should not be influenced by any possible yearly fluctuations in the prevalence of the trouble.

The examinations had not progressed very far before it became evident that there was a degree of infection in the hogs raised near Boston which considerably exceeded anything hitherto known. At the same time my attention was naturally directed to the nature of the feed which they received. I soon learned by inquiry that many of the raisers fed their hogs largely on city offal. I hoped that the material which came to me for examination would embrace many raisers who did not, as well as many who did, feed city offal; and that it would be possible, by a comparison of the results in the two classes of cases, to arrive at a definite opinion as to whether the offal was or was not responsible for the large proportion of trichinous hogs. In this I have been disappointed, inasmuch as nearly all the raisers — 51 out of 56 — whose hogs I have examined to the number of fifteen or more have made use of offal. While this prevents the presentation of comparative statistics which would be of value, it in no way diminishes my apprehension that city offal may be largely responsible for the prevalence of trichinæ here. At least, I shall not be satisfied that city offal is free from danger until it has been established by suitable experiments that the proportion of trichinous hogs cannot be reduced by wholly excluding it from their feed.

In the supplement to the first annual report of the State Board of Health, Lunacy and Charity of Massachusetts (1879, page 38) were published the results of the examinations for trichinæ in swine, made by Dr. F. S. Billings, V. S. Out of the 2,701 hogs examined, 154 were trichinous, the ratio of trichinous to non-trichinous hogs being 1:17.54; stated in another form, about 5.7 per cent. were trichinous. Of these, only 12 were raised in the vicinity of Boston. In the third annual report of the State Board of Health, Lunacy and Charity (page xlvi) the results of

the examination by Dr. Billings of 6,068 additional hogs, mostly from the Western States, showed the per cent. to be somewhat less than in the first report. Only 191 out of the 6,068 were infected; *i. e.*, 1 in every 31.77, or 3.15 per cent.

During October and November, 1881, I examined thoroughly *the pillars of the diaphragm only* from 500 hogs. The results have been given by Dr. Abbott in the supplement to the fifth annual report of the Board (page 182). Of the 500 hogs, 10, or 2 per cent., were found to be trichinous. In each case nine slips of meat from one "pillar" were examined. Three of the ten cases were only slightly infected. Had the examination been restricted to the first three or even to the first six slips, instead of nine, the result would have been negative, since the single specimen of trichina observed was found in the ninth, the eighth, and the ninth slips respectively in the three cases. One of the specimens of meat was further tested to ascertain the proportion of trichinæ in relation to the number of slips. Thirty slips in all were examined, and only five trichinæ were found; so that, had the worms been *evenly distributed* through the muscles, one would have found a single worm in each group of six slips. The possibility of overlooking the existence of trichinæ in such a mild case as this, even with the examination of six slips, is evident, since it cannot be assumed that the worms are evenly distributed through the muscle. Observation has shown repeatedly that the reverse is true; not only that different muscles but also that different parts of the same muscle may be infected in very different degrees.

I have dwelt at some length upon these examinations, because in nearly all subsequent examinations only *six* slips were employed; and it is therefore evident that some correction should be applied to the results, in order to satisfy the probability that the trichinæ of certain specimens have been overlooked, owing to their infrequency and the small number of slips examined. It would be quite unfair to infer, however, that the results which I have arrived at should be corrected by adding *three* to every seven found by the examination of six slips to be trichinous. For, in the first place, I believe, from the results of other observations, com-

plete records of which were not kept, that three such cases in ten is an unusually large proportion; and, secondly, if it were certain that out of every ten trichinous hogs three were so feebly infected that nine slips must be prepared to secure one trichina, there is no reason to suppose that the slip containing the single trichina would be the seventh, eighth and ninth, any more than the first, second and third; so that, if six slips were examined, the chances are that in two-thirds of these cases the trichina would be found. Thus, at most, there would have to be added *one* — not three — to each seven found trichinous, in order to counterbalance the probable oversight. But, as I have said, I believe that this is much too large a correction. One to ten, or even one to twenty, would probably be much nearer the reality. Supposing, however, that for every ten found by such examination to be trichinous one were to be added; even that could have very little practical importance, especially when those which are shown positively to be infected reach such high numbers as appear in this report. It is in view of the comparative insignificance of this error that I have ventured to limit my examinations to six slips, and have concluded that the degree of accuracy attained was sufficient for all practical purposes. It is to be remembered that this series of examinations has been undertaken not as an *inspection* of pork, where the examination should be rigid and as nearly absolute in its results as possible, but simply as a means of finding an approximate answer to the question, What proportion of the hogs raised in a given district are trichinous?

In order that the examination should be as thorough as possible under these conditions, the slips were taken each from a different part of the "pillar," so that no considerable portion of the specimen remained without inspection. The six slips together weighed on the average about twelve centigrams (one grain); they were cut in the usual manner, with scissors, laid on a glass slide, and covered by a slightly narrower slide of thinner glass. The cover-slide was ruled lengthwise with parallel lines, slightly closer together than the diameter of the field of the microscope, to aid in counting the number of trichinæ in the infected specimens. The cover-slide was applied with the ruled side down; that is, in

contact with the meat. In counting, only the worms embraced between two lines were considered while the slide was being moved in one direction; when the end of the slide was reached, the next adjoining space between two lines was observed while the slide was slowly moved in the opposite direction. In this way the whole slide was accurately examined without danger of counting more than once any single specimen of the worm. The meat was of course firmly pressed between the two slides, so as to flatten it and make it transparent; and a slight pressure was continued by means of the thumb and finger with which the slide was grasped in moving it back and forth.

The magnifying power employed was usually thirty or forty-five diameters. In addition to noting the specimens of meat which were infected with trichinæ, and also the number (approximately) of worms found in each case, a record was kept of the *sex of the hogs* on which the examinations were conducted, so that the results show the proportion both of males and females that were found to be trichinous.

TABLE I. — *Summary of Results of Examinations for Trichinæ made on Hogs raised near Boston, 1883–88.*

Dates.	Serial Numbers.	No. of Hogs Examined.			No. of Hogs Trichinous.			Per Cent. Trichinous.			Remarks.
		M.	F.	M. and F.	M.	F.	M. and F.	M.	F.	M. and F.	
1883–84, . .	561–1109 (less 302),	141	105	246	18	22	40	12.77	20.95	16.26	The 302 foreign hogs were numbers 638–665, 693–743, 764–813, 860–982, 992–1046.
1884–85, . .	1109–1984, .	527	348	875	61	23	84	11.57	6.61	9.60	
1885–86, . .	1984–2656, .	490	182	672	80	23	103	16.33	12.64	15.33	
1886–87, . .	2656–3271, .	390	225	615	59	24	83	15.13	10.67	13.50	
1887–88, . .	3271–3927, .	413	243	656	58	26	84	14.04	10.70	12.80	Embraces 32 hogs, fed on city swill, from Manchester, N. H.
1883–88, . .	Totals, .	1,961	1,103	3,064	276	118	394	14.07	10.61	12.86	

TABLE II. — *Summary of Results of Examinations for Trichinæ made on Hogs from State Institutions, 1884–88.*

Dates.	Serial Numbers.	Number Examined.	Number Trichinous.	Per cent. Trichinous.
1884–85,	12020–12109 (less 4),	85	11	12.94
1885–86,	12111–12163,	52	14	26.92
1886–87,	12163–12227,	64	11	17.19
1887–88,	12227–12260,	33	6	18.18
1884–88,	Total State Institutions,	234	42	17.95
1883–88,	Total near Boston,	3,064	394	12.86
1883–88,	Total Massachusetts,	3,298	436	13.22

Index List of Fifty-six Raisers and Eight State Institutions.*

[Tables III. and IV.]

Ser. No.	Location.	Ser. No.	Location.
1,	Bunker Hill.	34,	Hingham.
2,	South Boston.	35,	Milton.
3,	Milton-Randolph.	36,	Tewksbury.
4,	Newton.	37,	West Roxbury.
5,	Medford.	38,	Revere.
6,	Canton.	39,	Canton.
7,	Malden.	40,	Dedham.
8,	Watertown.	41,	Bunker Hill.
9,	Arlington.	42,	Arlington.
10,	Woburn.	43,	Arlington.
11,	Arlington.	44,	Canton.
12,	Milton.	45,	Randolph.
13,	Canton.	46,	Somerville.
14,	Brighton.	47,	Arlington.
15,	South Braintree.	48,	Dedham.
16,	Mattapan.	49,	Weston.
17,	Hingham.	50,	West Roxbury.
18,	Mattapan.	51,	Arlington.
19,	Waltham.	52,	Holbrook.
20,	East Cambridge.	53,	Weston.
21,	Randolph.	54,	Weston.
22,	Hingham.	55,	East Braintree.
23,	West Roxbury.	56,	Hingham.
24,	Everett.		
25,	Somerville.	1,	Danvers Lunatic Hospital.
26,	Belmont.	2,	Lancaster Industrial School.
27,	Charlestown.	3,	Monson Primary School.
28,	Manchester, N. H.	4,	Northampton Lunatic Hospital.
29,	South Boston.	5,	Taunton Lunatic Hospital.
30,	Canton.	6,	Tewksbury Almshouse.
31,	Dedham.	7,	Westborough Reform School.
32,	Hingham.	8,	Worcester Lunatic Hospital.
33,	Quincy.		

* The names of the raisers are withheld.

TABLE III. — *Results of Examinations, tabulated by Years, for all Raisers near Boston who have furnished Fifteen or more Hogs.*

Ser. No.	'83-8.	'83-4.	'84-5.	'85-6.	'86-7.	'87-8.	Ser. No.	'83-8.	'83-4.	'84-5.	'85-6.	'86-7.	'87-8.
1,	20:7	-	-	-	-	20:7	30,	23:3	5:0	7:1	5:1	-	6:1
2,	17:0	-	17:0	-	-	-	31,	35:9	-	-	13:5	17:4	5:0
3,	82:9	15:2	24:1	22:5	12:0	9:1	32,	43:1	26:1	1:0	1:0	5:0	10:0
4,	15:0	-	3:0	4:0	5:0	3:0	33,	16:3	-	4:2	-	6:1	6:0
5,	18:1	-	18:1	-	-	-	34,	41:10	-	-	-	17:6	24:4
9,	22:4	-	5:0	-	4:1	13:3	35,	21:3	-	10:1	11:2	-	-
7,	27:3	10:2	1:0	16:1	-	-	36,	65:2	-	65:2	-	-	-
8,	17:1	7:0	-	-	-	10:1	37,	35:4	-	-	35:4	-	-
9,	27:3	-	8:0	15:3	3:0	1:0	38,	27:5	-	-	-	27:5	-
10,	101:11	-	29:1	44:8	17:1	11:1	39,	19:1	9:1	4:0	3:0	3:0	-
11,	22:2	-	22:2	-	-	-	40,	19:3	-	-	-	16:3	3:0
12,	41:12	12:5	29:7	-	-	-	41,	16:3	-	6:0	-	3:2	7:1
13,	85:9	-	42:3	-	40:4	13:2	42,	40:9	-	-	-	40:9	-
14,	45:1	-	10:0	35:1	-	-	43,	20:3	(1881) 11:2	9:1	-	-	-
15,	16:3	-	-	16:3	-	-	44,	44:6	-	10:3	-	6:0	28:3
16,	67:16	-	26:7	2:0	15:5	24:4	45,	30:3	-	-	12:1	18:2	-
17,	33:4	-	-	-	18:2	15:2	46,	23:1	-	23:1	-	-	-
18,	20:7	5:3	5:1	7:1	3:2	-	47,	24:1	7:0	17:1	-	-	-
19,	42:5	-	8:0	25:3	9:2	-	48,	20:2	-	-	20:2	-	-
20,	16:2	4:0	4:0	4:2	4:0	-	49,	22:5	-	-	15:4	-	7:1
21,	55:10	20:5	12:3	-	5:0	18:2	50,	18:0	-	18:0	-	-	-
22,	40:5	-	10.1	16·2	4:0	10:2	51,	24:3	-	-	15:3	3:0	6:0
23,	25:5	-	-	-	-	25:5	52,	16:0	-	-	-	-	16:0
24,	22:5	7:3	6:1	4:1	-	5:0	53,	15:1	-	3:0	-	-	12:1
25,	15:4	-	1:0	-	14:4	-	54,	16:0	-	16:0	-	-	-
26,	47:9	-	-	-	47:9	-	55,	18:1	-	3:1	15:0	-	-
27,	25:2	-	13:2	4:0	4:0	4:0	56,	37:3	-	-	-	37:3	-
28,	32:7	-	-	-	-	32:7							
29,	46:14	-	-	-	46:14	-							

1767 : 246 = 13.92 per cent.

TABLE IV. — *Results of Examinations, tabulated by Years, for all State Institutions from which Material has been received.*

Serial Numbers.	'83-8.	'83-4.	'84-5.	'85-6.	'86-7.	'87-8.
1, . . .	7:2	-	7:2	-	-	-
2, . . .	6:0	-	3:0	1:0	2:0	-
3, . . .	22:1	-	7:0	15:1	-	-
4, . . .	137:35	-	31:8	16:10	57:11	33:6
5, . . .	18:4	-	6:1	12:3	-	-
6, . . .	36:0 [65:2]*	-	25:0 [65:2]	8:0	3:0	-
7, . . .	5:0	-	3:0	-	2:0	-
8, . . .	3:0	-	3:0	-	-	-

* The numbers bracketed are the result of examinations on specimens which were not received directly from the institution, and are included under No. 36 of the preceding table. *Omitting these, the totals are 234 : 42 = 17.95 per cent.*

TABLE V. — *Number of Parasites found in a Grain of Muscle in Each of 436 Cases.*

6	2	1†	2	2	6	14	2	2	2†	2	1
3	1	4	2	3	2	4	7	12	1	1†	2
1	7	1	1†	1†	1	3	227	11	2	5	7
80	10	19	35	9	7	3	1†	12	3	12	2
12	2	7	33	2	56	11	1†	10	6	8	3
5	2	5	31	13	2	7	2†	3	1†	1	5
8	4	67	6	5	71	24	3	2	64	4	2
5	4	1	4	1	9	8	1†	3†	3	3	41
45	1	1	2	1	2†	10	9	1†	20	9	5
5	12	5	4	85	3	8	3	1†	3	7	8
4	24	23	1	2†	13	5	3	5	21	11	1
5	1	2	1†	8	66	2	4	2	146	1	2
8	40	6	1	4	6	187	4	1†	10	69	3
9	2	2	1	99	43	1	9	1†	135	12	12
25	2	1	57	2†	4	1	2	5	1†	80	1
5	3	23	88	1	3	2	1	13	4	1	1†
2	2	8	5	8	7	5	52	2†	5	3	9
5	2†	2	60	4†	5	124	3	9	1	5	16
9	54	6	3	9	3	10	2	2	2	23	1
5	6	2†	2	1	5	8	5	25	7	4	2
60	1	1	2	8	5	2	7	9	12	5	3
90	4	5	52	5	1	7	200	108	5	63	300
2	12	2	23	1	2†	117	2	21	2†	3	2
2	21	1	1	97	3	27	13	2	10	7	4
4†	4	1	3†	10	1	10	8	2	5	65	7
1	1	1†	2	14	6	7	9	5	7	2	250
4	1	6	1	1†	16	5	1†	4	6	48	1
1	33	1	1	3	95	2†	1†	65	22	5	3
2†	50	35	14	6	2	1	1	2	20	2	1
1	1†	70	8	4	1	1	2	3	6	1†	8
1	32	7†	3	2†	1†	1†	6	1	1†	6	350
13†	3	18	1	27	12	2	9	5	900	3	394
3†	4	8	2	1†	27	83	20	44	6	3	

† The dagger indicates that the trichinæ were dead.

State Institutions.

3	2	3	6	1	1	3	1	13	21	3
2	1	2	4	24	5	5	8	1	3	4
1	9	1	3	1	2	40	8	1	4	42 394
6	20	26	6	5	67	14	14	31	16	436

An inspection of the above tables shows that, of the 3,064 hogs raised near Boston, 394, or 12.86 per cent., were trichinous; and that, for the several years over which the examinations extended, the lowest per cent. of infection was 9.6, the highest 16.26.

As regards the sex of the hogs, there were nearly twice as many females (1,961) as males (1,103) examined. The degree of infection among females was 14.07 per cent., while in the males it was only 10.61 per cent. It is noticeable that there was greater fluctuation from year to year among the males (20.95 per cent. maximum; 6.61 per cent. minimum) than among the females. The per cent. with the latter never fell much below 12. I know of no grounds upon which the comparative immunity of the males from infection can be explained.

Only 234 hogs slaughtered by State institutions have been examined, but of these, 42, or 17.95 per cent., were trichinous. Over half of these were received from one institution, where specially dangerous conditions were discovered, which may serve to explain in part the high degree of infection. This case will be considered farther on. The combination of these two tables of results gives, as the total number of hogs examined from Massachusetts, 3,298, of which 436, or 13.22 per cent., were trichinous. Besides these, I have examined from all other sources — principally Western, and *including the 500 reported on in 1881* — 888 hogs, of which 21, or 2.36 per cent., were trichinous.

Table III. gives the results of examinations in fifty-six cases, tabulated by years. They embrace all the cases of hogs raised near Boston in which as many as fifteen hogs from the same source have been secured for examination. The number before the colon shows the number of hogs examined; that after the colon, the number found to be trichinous. Table IV. gives similar statistics from eight State institutions.

In Table V.* is given the number of encapsuled worms found in each of the 436 cases discovered in hogs raised near Boston or in State institutions. The amount of muscle examined was subject to some variation, so that the figures

* A dagger (†) following a number indicates that the parasites were dead.

can be considered only as rough approximations to an index of the degree of infection, but on the average it was about one grain of flesh from each hog. A synopsis of the cases is as follows: —

With	1	parasite	87	cases	÷ 1 =	87.*
"	2–5	"	171	"	÷ 4 =	43.
"	6–10	"	74	"	÷ 5 =	15.
"	11–19	"	29	"	÷ 9 =	3.2
"	20–49	"	36	"	÷ 30 =	1.2
"	50–99	"	27	"	÷ 50 =	.54
"	100–900	"	12	"	÷ 800 =	.015
	Total,	.	436			

In 45 cases one or more of the parasites were dead.

What degree of infection is implied by finding only one trichina in six slips from a single hog? To find only one specimen of the parasite would seem, at first sight, to mean a degree of infection which is of little or no significance, either to the animal infected or to the consumer. But, however unimportant the infection may have been in the life of the hog thus feebly affected, even such cases are capable of producing serious results in the consumer. As has been said, the amount of meat examined from any one hog is excessively small — only about one grain. Since in a pound of meat there are 7,000 grains, it follows that, if one were to eat half a pound of such meat uncooked he would import into his person no less than 3,500 living worms, over half of which it has been proved would be productive females, each one of which would bring forth at a minimum about 1,500 minute worms, or, at a very low estimate, an aggregate of say two and one-half million worms. But, assuming that the average infection of the body falls considerably below that of the pillars of the diaphragm, — assume it to be one-fifth the latter,† — still the number of migrating young trichinæ (half a million) would doubtless be enough to have a real effect on the health of the patient.

* The figures of the last column are averages for the lots, obtained by dividing the number of cases by the number of grades embraced in the corresponding lot; thus, "2–5 parasites" embraces four grades — the 2- 3- 4- and 5- parasite grades.

† A little farther on there are presented some facts and estimates on the degree of infection.

But there is another reason why it is important to show the significance of what appear to be cases of feeble infection. I wish to know whether it is probable that the infection in these mild cases has been due to the adventitious importation of young trichinæ previously voided with the fæces of infected animals living in the same pen. One might naturally infer that all such mild cases came about simply by being associated with animals that were infected, and that it by no means implied the consumption of trichinous meat on the part of the mildly affected hog. But I believe that there is very little ground in support of such a theory, and that probably all, or at least very nearly all, the cases reported here imply the consumption of uncooked trichinous meat on the part of the infected animal.

It may be assumed that the weight of the lean meat of an average sized hog is 50 pounds,* or 350,000 grains. Since in each grain of flesh examined there was found at least one trichina, the mildest cases recorded would contain not less than 350,000 encapsuled worms, *if all the muscles of the body were as thoroughly infected as are the pillars of the diaphragm.* But observations have shown that that is not the case. Billings † has cited the results of the studies of Johow and Maximilian on the distribution of trichinæ in the hog, which may be summarized as follows. Specimens were taken from six muscles of each of four hogs. It is to be assumed — though it is not so stated by Billings — that the number of slips taken from each of the muscles was the same, for otherwise the results would have no significance in ascertaining the distribution of the trichinæ. The pillars of the diaphragm were considered separately from the other muscles of the diaphragm. The number of trichinæ found in each of the muscles is given in a table below (page 125). For the purpose in view, it is only necessary to ascertain the ratio of the worms found in the pillars of the diaphragm to the total number of worms found. This ratio, in the cases

* Leuckart ("Menschl. Parasiten," Bd. II., p. 532) assumes that the muscles of a person weigh forty pounds, and Huxley ("El. Lessons in Physiol.," Revised Ed., p. 365) puts the weight of the "muscles and their appurtenances," for a person weighing one hundred and fifty-four pounds, at sixty-three pounds.

† Supplement first annual report State Board of Health, Lunacy and Charity of Massachusetts, 1879 (pages 27, 28).

of the four hogs, was as follows: 12 : 17, 10 : 18, 40 : 85 and 40 : 98; or, combining all four, the ratio is 102 : 218. It therefore follows that the examined portions of the pillars contained nearly as many trichinæ as all the other portions of examined muscles put together, or nearly 50 per cent. of the worms discovered. But the *degree* of infection, neglecting for the moment the disparity in the weight of different muscles, is to be ascertained by dividing the number of parasites by the number of muscles in which they are found. The *average* degree of infection for all parts examined is therefore expressed by (218 ÷ 6 =) 36, while the degree of infection for the pillars of the diaphragm is expressed by (102 ÷ 1 =) 102. Consequently, the ratio * between the degree of infection in all the muscles examined and that in the pillars is 36 : 102, or approximately 1 : 3. But the muscles examined by Johow and Maximilian were principally those which are most liable to be infected. It would evidently be

* This ratio would not have been greatly altered had the "pillars" been regarded as a part of the diaphragm, provided the examinations of the whole diaphragm had resulted in finding the same number of trichinæ as the average of the results from pillars and diaphragm examined separately. This will appear from a comparison of the following table of their results, and computations based on the above assumptions: —

*Distribution of Trichinæ in Hogs, according to Johow and Maximilian.**

REGION EXAMINED.	NUMBER OF TRICHINÆ.					NUMBER OF TRICHINÆ (ASSUMED).				
	HOG.					HOG.				
	No. 1	No. 2	No. 3	No. 4	Total.	No. 1	No. 2	No. 3	No. 4	Total.
1. Pillars of diaphragm, ...	12	10	40	40	102	8	8	33	35	84
2. Muscles of diaphragm, ...	4	6	25	30						
3. Laryngeal muscles, ...	1	2	4	10		1	2	4	10	
4. Intercostal muscles, ...	0	0	6	10		0	0	6	10	
5. Tongue muscles, ...	0	0	8	6		0	0	8	6	
6. Neck, eye and humerus, . . .	0	0	2	2		0	0	2	2	
Totals, ...	17	18	85	98	218	9	10	53	63	135

* The first series of four columns exhibits the results as given by Johow and Maximilian; the second series of four columns shows what the result would have been on the above assumptions. The ratio derived from the numbers 102 and 218 has been explained above. The ratio upon the new assumptions would be — dividing each total by the number of muscles furnishing the trichinæ — (135 ÷ 5 =) 27 : (84 ÷ 1 =) 84, or 1 : 3.1; which is only slightly in excess of the ratio obtained when pillars and diaphragm are considered separately.

unfair, therefore, to put the average infection of the whole body as high as that of the muscles examined. Perhaps it would not be unreasonable to assume that the muscles less liable to infection — *e. g.*, those of the legs and back — would have been comparatively free from parasites; and since, on the whole, the muscles not examined greatly exceed in weight those which were, it would probably be not far from the truth to suppose that the including of such muscles in the examination would have reduced the average infection of the whole body to half the average infection of the muscles which were examined. Upon that assumption the pillars of the diaphragm would be six times as badly infected as the muscles of the body taken as a whole.

This result agrees fairly well with the examinations of Kühn, cited by Leuckart ("Untersuch. über Trichina spiralis," 1866, pp. 105, 106). Kühn examined fifteen different muscles from each of three hogs, with the total result that the diaphragm — not the pillars alone — contained 25 per cent. of all the worms found. Now, if the worms had been evenly distributed, he would have found in the diaphragm only ($100 \div 15 =$) $6\frac{2}{3}$ per cent., instead of 25 per cent. That is to say, the diaphragm is four times as badly infected as the average of all the muscles examined. Since the muscles examined by Kühn were not limited to those which usually show the larger proportion of trichinæ, it is fair to assume that the proportions which he found would hold good if every muscle of the body had been examined. That proportion is not very far from the results which the examinations of Johow and Maximilian would indicate, according to the view which I have taken of their investigation. In Kühn's case,* however, the fact that the muscles falling

* Kühn's results, which are slightly defective, from the omission of the ear-muscles and the extensors of the thigh, — they not having been uniformly examined, — are as follows: —

Muscles.	Trichinæ. Per cent.	Muscles.	Trichinæ. Per cent.
Diaphragm,	25.3	Eye,	3.6
Shoulder blade,	14.0	Belly,	3.6
Lumbar region,	11.3	Extensors, fore leg,	3.1
Larynx,	8.5	Nape,	2.6
Flexors, hind leg,	7.0	Flexors, fore leg,	2.5
Neck,	4.8	Intercostal,	1.7
Tongue,	4.7	Dorsal,	0.3
Cheek,	4.4		

below the average degree of infection ($6\frac{2}{3}$ per cent.) outweigh those which exceed it, would tend to diminish the average degree of infection for the whole body, and consequently to raise the ratio of the infection in the diaphragm to that of the whole body. I believe, then, in view of these two results, that one will not greatly err in assuming that the pillars of the diaphragm are at most five times as thoroughly infected as are the muscles of the body in general. But, even with this difference between the pillars and the other muscles of the body, there would still be in the mildest case here recorded not less than 70,000 encapsuled worms; a number which implies that they are the progeny of at least 46 fertile females, — reckoning the total offspring of each female at 1,500.

It is known that both embryos and gravid females are capable of living outside a host (*i. e.*, in fæces) only a short time, probably never more than twenty-four hours. (Leuckart, "Menschl. Parasiten," Bd. II., p. 558.)

That sexually mature females (*i. e.*, intestinal trichinæ), as well as embryos, are occasionally eliminated from the intestine of an infected pig, has been shown by a number of observers (Leuckart, Kühn, Vogel, Gerlach, *et al.* See Leuckart, "Menschl. Parasiten," Bd. II., p. 557); but it is still questionable whether the adult worms are able to withstand the action of the digestive fluids of the stomach when they are imported into a second host. Leuckart (*op. cit.*, p. 557–561) has discussed this point at some length; and, not only from the absence of satisfactory proof in the case of trichinæ, but also on general grounds, doubts the possibility of infection in that manner. If the sexually mature females of trichinæ were capable of withstanding the digestive fluids of a new host, they would form an exception, he says, to all other helminths, none of which are capable of enduring *at that stage of their existence* a change of host. I believe, then, that one is safe in assuming that a degree of infection which implies the importation of 46 gravid females precludes the explanation suggested. The importation of 70,000 separate embryos through fæces seems to me to be an equally unreasonable assumption, even admitting that the embryos are more capable than adults of resisting the digestive fluids in the stomach of the second host.

But there is still another, and, one must admit, more probable, source of infection through the contents of the fæces. Leuckart (*op. cit.*, p. 561) calls attention to the fact that, up to the third day after feeding with trichinous flesh, the intestines of the animal experimented upon may contain fragments of meat which are incompletely digested, and which may still contain encapsuled trichinæ in a more or less normal condition. Occasionally, he adds, such fragments may be found in the fæces. Of course, the importation of such fragments derived from the fæces would be just as dangerous as the eating of so much meat which had not passed through the intestine of another animal; besides, in that condition, — more or less protected from desiccation by being enveloped in the fæces, — the encapsuled trichinæ might survive for a long time. But I cannot think that anything except an unusual combination of circumstances would lead to so extensive an infection even by this means.

Taking all these facts into account, I do not believe that any considerable proportion of even the mildest cases reported here can be accounted for on any other assumption than that of direct infection by the eating of meat containing encapsuled trichinæ. But, granting what certainly is possible, that a very small proportion of the cases exhibiting one worm to a grain of flesh are thus accounted for, it is evident that this must be more than counterbalanced by the fact that there are probably many cases of *direct infection* of a type still milder than the feeblest of those here reported. From the computations which have just been made, it is clear that any case in which less than 46 females came to maturity in the intestine of the host, would present a degree of infection which might escape detection by a process of examination such as I have followed.

I think, therefore, that these inferences may be drawn: (1) That the cases of indirect infection — *i. e.*, through fæces — lie for the most part quite outside the possibility of discovery by any examination which is limited to one grain of flesh; and (2) that the cases of direct infection which are also too mild to be discovered by that standard of examination exceed those resulting from indirect infection which may have been detected, and thus have helped to swell the

total number of cases reported. If these inferences be just, the results which are furnished by my examinations certainly do not exceed the actual number of infections which have taken place as the direct result of eating trichinous meat.

The important question, then, is: What are the sources from which hogs get the infected meat? Fortunately, there are not many ways in which it is probable that dangerously infected meat could be got; *i. e.*, there are not many animals in which trichinæ are found with sufficient constancy to warrant one in supposing that they could furnish a continuous supply for infection. One of these animals is, of course, the hog itself. But there is also another, — the rat, — which, from its carnivorous, or at least omnivorous, habits, is believed by many to be responsible for the perpetuation of trichinæ in hogs. Leuckart, who was the first to call attention to the rat as a harbinger and probable disseminator of trichinæ, has given many reasons, both general and special, upon which he bases his conclusions.

But, while rats may be the principal cause for the perpetuation of trichinæ in Europe, it should not be overlooked that nowhere else in the world has so great a proportion of trichinous hogs been found as among this three thousand raised in the vicinity of Boston. I cannot believe that the conditions here are any more favorable for the perpetuation of trichinæ through rats than in European cities. I think the hogs raised near Boston are not more closely confined, and that they do not have more inducement or opportunity to kill and eat rats, than in Germany. It must not be forgotten that the most of the hogs here reported on were not raised in close quarters within the city limits, but by farmers and hog-raisers in the suburbs, at distances varying from five to twenty miles from the city proper. But, on the other hand, it is undoubtedly true, that, wherever hogs are raised, rats are more or less abundant. They are attracted by the feed which is given to the hogs, and are likely to thrive most where they have freest access to it. City offal for the hogs probably affords rats a better means of subsistence than any kind of food which is better housed and cared for than offal is likely to be. So it may be that the offal is *indirectly* responsible for the trouble, in that it serves to attract more

rats than could be supported if other kinds of food and other methods of feeding were employed.

While I am inclined to regard the infection of hogs as more probably due to their eating uncooked swine-flesh contained in the offal than to their killing and eating rats, still, an investigation, to be at all satisfactory, should not ignore this latter possibility; and it is therefore desirable that some means should be found of gaining access, for the purpose of inspection, to the hog-pens of raisers in this vicinity, and, if possible, of securing the co-operation of the raisers, in ascertaining the prevalence of rats, and whether it is common for hogs to eat them.

However true it may be, that, owing to the rats, we should never be able entirely to get rid of trichinæ in hogs, even if we could by a decree destroy every one now existing in them, still, I doubt if rats are the only or even the principal cause of the present alarming prevalence of this parasite in the pork raised in the immediate vicinity of Boston. I suspect that hog-flesh is, after all, a greater source of the difficulty than rat-flesh.

There are two principal ways in which it is possible for pork to keep up the infection in hogs. It is a custom with some private slaughterers, even with the better class of people and those otherwise well informed, to cast the viscera of slaughtered animals, swine among others, to the pigs. No surer way could be devised for perpetuating and increasing the infection with trichinæ.* At one of the State institutions this practice was kept up until January, 1887, when it was abandoned, as a result of some of the examinations here reported, and the consequent discovery of the enormous per cent. of trichinæ (26 per cent.) found in the pork raised and slaughtered at that institution. It is hoped that the discontinuance of this practice will speedily show some diminution in the number of hogs containing trichinæ.

But the acquisition of trichinæ through the viscera of slaughtered hogs is precluded in the case of those raisers

* The danger which ensues to hogs, in consuming the viscera of slaughtered animals, is not so much due to the possibility of infection from intestinal trichinæ or young embryos, as from encapsuled muscle trichinæ. Small in amount as the voluntary muscles are which are attached to the viscera (œsophagus, diaphragm, rectum, etc.) they are sufficient to constitute the principal source of danger.

who habitually send their hogs to the large private slaughtering houses of the city, and who do not receive the viscera from those institutions. Such is the practice of most of the large raisers in the vicinity of Boston, and in particular is true of all of the 56 raisers enumerated in Table III.*

The only other suspected source, aside from the rats, is the ordinary food of the hogs. In all cases, without doubt, this is to some extent kitchen offal. In the case of 51 out of the 56 raisers enumerated in Table III., city offal is known to constitute a large share of the food given to the hogs.

It may prove to be merely a coincidence, and of no importance, that hogs which are fed on city swill show a proportion of trichinous individuals far in excess of those which come from the West, among which offal-fed animals must be much less numerous than here; but it is a coincidence which at least merits a careful examination.

The probable sources of the principal part of the infection in this vicinity appear to me to be limited to these two, — rats and city offal. The only way to ascertain which of the two is the greater source of danger, is to eliminate as far as possible one of the supposed causes, *without interfering with the previously existing conditions of the other.* It will evidently be easier to control the nature of the regular food of hogs, than to eliminate the rats. With honest supervision, there need be no doubt of the completeness of the experiment in excluding all uncooked meat; but, with the most scrupulous attention, it might not be possible to secure absolute exclusion of rats, and the uncertainty in this respect would render the experiment less satisfactory than the control of the regular food.

There are also certain facts which seem to me already to point to the offal as the more probable source of the difficulty. That being the case, there would be greater hope of ascertaining the principal cause quickly, if this source were the first to be removed. One of the facts which seems to me to point to the offal rather than to the rats, is that so large a proportion of all the hogs are thus infected. It seems improbable that every eighth hog should find the opportunity

* It is a common thing, however, for some of these raisers themselves to slaughter a portion of their hogs for the purpose of supplying neighboring retail dealers.

to eat a rat, or any portion of one; and I doubt it the more, since raisers rarely or never know of such an occurrence; whereas, the presence of a small amount of raw lean pork in the offal — especially if 13 per cent. of all the pork were trichinous — would afford frequent opportunity for one or more hogs to become infected.

A second consideration of some weight is the probability that, other things being equal, the degree of infection in hogs acquiring trichinæ by eating rats would be more uniform and in general more thorough than in hogs infected by eating such fragments of pork as might make their way into kitchen refuse. Not that there would necessarily be any greater uniformity in the degree of infection in the rats themselves than in the pork, but that a larger amount of muscle would be consumed in the former than in the latter case.

That raw meat should find its way into the city offal is not at all surprising, even in view of the general practice of reserving for soap whatever may be serviceable as fat. That practice, it is certain, must greatly diminish the danger of infection from this source, but it cannot be sufficient to wholly preclude the admission, especially of fragments of lean meat and joints with portions of the muscle still attached.* Even a cursory inspection of the contents of offal-carts has shown me that uncooked meat finds its way into city offal; but to what extent, it would of course be very difficult to ascertain, owing to its heterogeneous nature. The raw meat probably does not come from the butchers' shops nor from the kitchens of hotels and public restaurants, because in these places greater system prevails in the disposal of whatever may be made to yield a money return; it is rather from the refuse of private kitchens — where it must often be a matter of indifference to the "help" whether the trimmings from a piece of pork go into the soap-grease or the offal-box — that the supply is kept up, — a supply which need not be great in amount to insure the results.

Another fact of some importance is, that nearly half (149

* It is well known that the portions of a muscle which are most thoroughly infected are the ends near their attachment to bone; so that the fragments of meat remaining on bones are likely to be of more than average danger.

out of 351, or 42.4 per cent.) of all the raisers whose hogs have been examined have had hogs containing trichinæ. Even this statement does not give an adequate idea of the prevalence of the infection, because, in the majority of the cases where no parasites were found, the number of hogs examined was very small (*e. g.*, in 166 out of the 202 non-trichinous cases, fewer than 6 hogs were examined). Perhaps a more adequate idea of the prevalence of the parasite is to be had from the list of 56 already cited (see Table III., page 120), which embraces all the raisers who have furnished 15 or more hogs for the examinations here reported. Out of these 56 only 5 have furnished hogs destitute of trichinæ, and the number of hogs examined from each of these five raisers was respectively 17, 15, 18, 16, 16. It is, therefore, evident that no person whose hogs have been examined to the number of 19 raised pork destitute of the parasite. It is at least a striking coincidence, that, out of so many raisers whose hogs are badly infected with trichinæ, such a proportion have fed city offal.

What can be done further towards settling the question of the sources of infection? It appears to me desirable: (1) To ascertain if there are any raisers who feed brewery swill, or any other food containing no meat, to the exclusion of all kitchen offal. If there are such, to secure the examination of all the hogs they slaughter, ascertaining at the same time whether trichinous rats are to be found about their premises. (2) To make arrangements, by subsidies if necessary, with certain raisers who are known to have fed city offal and to have furnished badly infected hogs, to the end that some other feed, containing neither meat nor kitchen offal, shall be substituted for that at present used. This change of feed must, of course, extend over the whole lifetime of every pig upon which examinations are made for the purpose of ascertaining the effect of the absence of city offal. (3) To continue the examinations for trichinæ in pigs slaughtered at the State institution where the reform as regards the feeding of viscera has been effected, and where uncooked meat is now excluded from the feed, in order to ascertain what effect these changes produce. (4) To secure a more complete co-operation on the part of other State institu-

tions which raise and slaughter hogs, in order that a subsequent change in diet may afford additional opportunities to judge of the relative effects of offal feeding, and a possible consumption of rats.

EDWARD L. MARK.

CAMBRIDGE, April 16, 1888.

REPORT

ON THE

SALE AND USE OF OPIUM

IN

MASSACHUSETTS.

By B. H. HARTWELL, M.D., of Ayer.

THE SALE AND USE OF OPIUM IN MASSACHUSETTS.

This investigation was undertaken in accordance with the following Resolve, adopted by the Legislature of 1888: —

Resolved, That the State Board of Health be requested to make an investigation concerning the sale and use of opium, in various forms and preparations, with a view to ascertaining the extent of the evils arising therefrom; whether such use and evils are increasing, and, if so, the manner and cause thereof, and what remedies for such evils may be proposed; and to report the result of such investigation to the General Court.

This resolution was presumably an outcome of the prevalent belief that the use of opium is increasing very rapidly. An *exposé* of the opium joints in Boston appeared in one of the leading dailies in 1885; there have been frequent allusions to the habit in other papers; a recent article, claiming to be the result of years of study of the opium habit in Boston, was published in one of our popular magazines, in which the writer says that the habit "is increasing rapidly." In these and numerous other ways the public has been taught to believe that the evil is wide-spread and extending. The large number of opium *habitués* which seemed to be among us, the novelty of this form of stimulation, its secret character, the strong hold which it has upon its victims, the horrible results arising therefrom, especially from the habit of opium smoking, — all tend to keep the subject prominently before the people, and to magnify the evil in the public mind. To get at the facts concerning the use of opium (the term opium will include all of its preparations),

as far as possible, is the object aimed at in this inquiry. This is beset with many difficulties, from the very nature of things. There can be no reliable statistics of the amount of opium used by the medical profession, the laity, or by *habitués*, or the proportion used by each. The most rigid inquiry into a habit as secret and as easily practised as is this form of inebriety could not be sufficiently accurate for mathematical calculation; approximation only can be attained.

That a great deal of opium is used besides that legitimately required for the relief of pain and treatment of disease, is unquestionably true. The unwillingness of people to bear pain, the habit of self-prescribing, the many facilities for obtaining opium and its preparations from the regular dealers as well as by means of proprietary medicines containing it, the numerous ways by which a knowledge is gained of the method of obtaining and taking the drug, — all extend its use in the most dangerous manner.

As the best means for forming an opinion of the amount of opium used, and whether or not its use is increasing, circulars were sent to many of the druggists and physicians of the State; the questions asked, and a synopsis of the answers returned, are given below. Some allowance must be made in considering the returns, for the reason that opium *habitués*, from fear of detection or a desire for secrecy, scatter their purchases as much as possible; so that a druggist may easily get an impression of an increased or decreased use of the drug, while in reality the sales are going on elsewhere or have returned after the rounds have been completed. So also the same habitual users might be seen by different physicians, and counted several times, or escape notice altogether, and thus convey a false idea of the actual number. A circular containing five questions was sent to druggists. Replies were received from about 600 druggists, representing 190 cities and towns, and embracing nearly every city and town in the State where a druggist is located. (There are about 150 towns in which no druggist resides.) About one-fourth of the answers came from Boston, the rest from other parts of the State. Many of the returned circulars contained answers to all of the questions, others to only part of them;

hence the number varies in the different questions. The questions and answers were as follows: —

1. What amounts of opium are sold by you per month, not on the advice and prescription of a physician?

(*a*) Crude opium, opium in powder, in pill or other solid forms? 512 answers: 60 per cent., none; 25 per cent., 1 grain to 4 pounds each, average, 3.02 ounces; 10 per cent., "very little;" 5 per cent., a few pills.

(*b*) Liquid preparations. Tincture. 541 answers: 12 per cent., none; 8 per cent., "very little;" 25 per cent., 1 dram to 4 ounces; 20 per cent., 4 to 16 ounces; 35 per cent., 1 to 32 pints; average, 2.48 pints. Camph. tincture. 544 answers: 7 per cent., none; 6 per cent., very little; 20 per cent., less than one pint; 67 per cent., 1 to 40 pints; average, 3.57 pints each. McMunn's Elixir. 515 answers: 50 per cent., none; 20 per cent., "very little" (including those who sell 2 or 3 bottles a year); 30 per cent., 1 to 12 bottles. Other forms. 305 answers: 80 per cent., none; 12 per cent., very little; 8 per cent., small sales of morphia, Dover's powder, Tully's powder, and soothing syrup.

(*c*) Morphia and its salts, in bulk, in pill or powder? 540 answers: 33 per cent., none; 10 per cent., "very little;" 47 per cent., $\frac{1}{2}$ grain to 8 ounces of morphia, average, 9.56 drams each; 10 per cent., 2 to 500 morphine pills, mostly $\frac{1}{8}$ grain.

(*d*) Other preparations of opium, including empirical forms? 312 answers: 75 per cent., none; 15 per cent., very little; 6 per cent., 1 to 24 drams; the rest reported small sales of mixtures containing opium.

2. Is the demand for opium and its salts increasing? 535 answers: 85 per cent., no; 8 per cent., yes; 5 per cent., decreasing; 2 per cent., do not know.

3. Do those who are alcohol users employ opium as a substitute? 509 answers: 72 per cent., no; 3 per cent., yes; 17 per cent., do not know; 8 per cent., sometimes.

4. Has the use of patent medicines containing opium increased more rapidly than the increase of your population? 490 answers: 88 per cent., no; 3 per cent., yes; 9 per cent., do not know.

5. What classes of people use opium in your community?

446 answers: 22 per cent., all classes; 22 per cent., middle classes; 7 per cent., upper classes; 7 per cent., lower classes; 11 per cent., do not know of any who use opium; 11 per cent., do not know; 20 per cent., miscellaneous.

For obvious reasons, circulars were also sent to many of the physicians of the State who commenced practice before 1875. About 260 replies were received, from 100 cities and towns out of about 250 in which physicians reside. Eight questions were submitted, which, with the number and character of the answers, were as follows: —

1. From your own observation, is the use of opium and its preparations increasing in the community in which you live? 225 answers: 66 per cent., no; 28 per cent., yes; 6 per cent., do not know.

2. If such be the case, what is the probable cause of such increase? This question called for answers only from those who had answered the first question affirmatively; consequently, but 75 of a miscellaneous character were received. Twenty per cent. give the use of opium by physicians as the sole cause; 11 per cent. give this as the cause in part. Ease of obtaining opium from druggists, duplication of prescriptions containing opium, increased knowledge of its effects, excessive brain work, desire for stimulation, fast living, comprise most of the remaining answers.

3. Are diseases calling for the use of opium increasing? 209 answers: 84 per cent., no; 16 per cent., yes.

4. In what form or manner is it employed? 160 answers: 30 per cent., all forms; 22 per cent., morphia; 13 per cent., morphia and laudanum; 12 per cent., morphia by the mouth and hypodermically; 10 per cent., morphia hypodermically; 5 per cent., proprietary medicines; 8 per cent, do not know.

5. Does the prohibition of alcohol increase its (opium) use? 202 answers: 67 per cent., no; 10 per cent., yes; 3 per cent., possibly; 20 per cent., do not know.

6. What classes of people mostly use it? 166 answers: 30 per cent., all classes; 22 per cent., higher; 8 per cent., middle; 6 per cent., lower; 12 per cent., middle and higher; 14 per cent., nervous women; 8 per cent., do not know.

7. What remedies can be applied for the evil? 160 answers: 30 per cent., regulation of the sale of opium, or regulation combined with some other remedy; 20 per cent., education and moral means. Regulate duplication of physicians' prescriptions, restrict the use of opium by physicians, confinement in hospitals, stop the sale of proprietary medicines containing opium, comprise most of the other answers.

8. Has the use of so-called opium cures, and other patent medicines containing opium, increased? 197 answers: 33 per cent., do not know; 32 per cent., no; 35 per cent., yes. Answers were received to about one-half of the circulars sent out; 75+ per cent. of those relating to the increased use of opium were in the negative.

The importations of opium into the United States since 1870, as given in the United States commerce and navigation reports, were as follows: —

In 1870,	254,609 pounds.	In 1880,	533,451 pounds.
1871,	315,121 "	1881,	318,710 "
1872,	416,864 "	1882,	370,249 "
1873,	319,134 "	1883,	457,499 "
1874,	395,909 "	1884,	331,172 "
1875,	305,136 "	1885,	384,434 "
1876,	388,311 "	1886,	517,483 "
1877,	349,223 "	1887,	634,494 "
1878,	430,950 "	1888,	513,006 "
1879,	405,957 "		

There were re-exported, in 1886–87–88, 42,408, 64,168, and 33,303 pounds, respectively. Taking the amount of opium per capita in the United States (not allowing for that re-exported), on an estimated population of 60,000,000 at the present time, and we have 62.50 grains between 1870 and 1880, and 54.26 grains during the nine years from 1880 to 1888 inclusive; showing a decrease per capita of 8.24 grains, so that, while the figures of the above table show an increased amount of the drug imported each year, that increase does not keep pace with the increase of our population. This applies to the United States. There are no means of ascertaining the amount brought into Massachusetts; but we have no reason for supposing that the inhabitants of our State are more addicted to the use of opium than

other States of the Union. The amount of the salts of opium imported is very small, compared with the crude drug; being, according to statistics from the Bureau of Statistics, treasury department at Washington, only $\frac{1}{68}$ part in 1888 (that is, the equivalent of the crude drug), or 1,250 pounds of morphia, with an average of 561 pounds for the twenty-three years last past. Of the extracts for medicinal use, only 46 pounds were imported in 1888; and of the liquid preparations, $39 worth, pounds not given. All of the preparations of opium imported, therefore (except the crude), are small in amount, in proportion to that re-exported. The amount of opium brought into the United States by other than natural channels is thought to be small, and most of that is opium prepared for smoking (this is not used in medicine), as this form, from its price and comparative ease of transportation, is the preparation likely to be selected for such purposes. The chief supply for the United States is in the form of the crude drug.

In considering the "manner and cause" of the large use of opium, it should be stated that it is probably true that the medical profession use less now than in previous years. In question No. 3, directed to physicians, the answers came three to one that diseases calling for the use of opium were not increasing; and, in many of the papers in which grounds were taken that such diseases were on the increase, it was stated that other drugs — the bromides, chloral, cocaine and antipyrine — were taking the place of opium in their treatment. Some of the physicians, in making up their replies to the above question, stated that they used less opium than formerly; some, that they were using more. The public hospitals, dispensaries and prisons of Paris are all supplied with drugs through the Pharmacie Centrale. A recent report from the records of this establishment for the past ten years, giving the increase and decrease in the use of different drugs, shows that the use of opium preparations does not change.

It is the opium *habitués* who use large and increasing quantities of the drug. Any increase or decrease in the gross amount used must therefore be charged to the greater or less consumption by them; due allowance being made

for that taken by self-prescribers, — who, by reason of the more general knowledge of its effects, and manner of use for the relief of pain, use more each year, either buying it without medical advice, as needed, or keeping it in the house, to be taken as required, — and also for the present extensive use of opium for the treatment of domestic animals.

As to the form or manner in which opium is taken, morphia is the preparation most frequently used by physicians, and is undoubtedly the one usually selected by habitual users, both on account of its convenience as regards bulk and taste, and from the fact that it is the one which is used hypodermically. In the druggists' returns of the amount of opium sold without a prescription, the three principal forms were 70 per cent. morphia, 25 per cent. laudanum, and 5 per cent. paregoric; and from physicians, 125 out of 153 answers were that morphia, as the only form, or as the chief one among others, was the preparation preferred. The manner of using the drug is mostly by the mouth, about 15 per cent. taking it by means of the hypodermic syringe, and occasionally one by suppository. While it is probably true that the use of opium, and the evils arising therefrom, are not increasing in a ratio greater than our population, still, a great deal is sold by druggists without a physician's prescription, according to their own returns; and, in accordance with all returns, much opium is used by all classes, and under all conditions, and the evils are many and untold.

Dr. Whitwell, in "Quarterly Review," says: "Like alcohol, the effects (of opium) are very different on people and on nations of diverse temperaments. The effect on the Burmese was peculiarly destructive. This simple and childlike people, totally ignorant of the danger, seized this new toy, and, experiencing exhilarating and pleasurable feelings, used it to great excess, and soon became utterly ruined. The Chinese, being a more phlegmatic and a wiser nation, while using it for its stimulating effect, still, as a rule, smoke it in more moderation; at least, the better classes do, and bear up more successfully against its deleterious effects. The effect in the lower and more ignorant class is different. A much revered gentleman of this city, who has spent years in China, tells me that villages which

he has known as happy and prosperous, have been entirely swept out of existence by the introduction of opium."

Williams, in his book, "The Middle Kingdom," quotes a Chinese scholar, who speaks of the habit as one "which exhausts the animal spirits, impedes the regular performance of business, wastes the flesh and blood, dissipates every kind of property, renders the person illformed, promotes obscenity, discloses secrets, violates laws, attacks the vitals and destroys life."

An anonymous writer, in referring to the opium habit, says the effects are perhaps most apparent among the Chinese. Population has fallen off from an annual advance of three per cent. to one per cent., and the natural increase is kept down by impaired fecundity. The Island of Formosa, — called the Island of Beauty, — whose inhabitants were formerly warlike and hardy, presents the spectacle of a race degenerated and enervated by the use of opium.

The "London Daily News" in a recent issue says: "The passion for opium is reported to be rapidly destroying the native population on the Marquesas Islands, where the women, even more than the men, are said to be addicted to this fatal indulgence. According to our consul at Tahiti, the French authorities are afraid that the result will be the same in the Society Islands, where, in spite of the stringent orders issued to the police, the Chinese persist in selling opium to the natives."

Dr. Levinstein of Berlin, in a monograph founded on personal observations, says: "The subcutaneous injection of morphia has, until the last few years, been but rarely practised in Germany. The facility of Pravaz's method, however, its rapid and marvellous action in relieving pain, and the calming effect it had upon the sick and wounded during the war of 1866, paved the way for its adoption in this country. The scope of its application was extended daily, without the slightest discrimination; and very soon this narcotic remedy was used to remove every abnormal sensation, whether caused by neuropathic or inflammatory action. The most prominent scientific men foresaw the danger which would result from this mania for morphia injections; and, by the bedside of the patient as well as at

the teacher's desk, spoke earnestly against its use, but without avail. The enthusiasm of the public for this remedy, on account of its marvellous action, spread rapidly; and, finding out that injections of morphia also relieved physical pain, they soon took out of the hands of the medical man a remedy which when only in the latter's possession would have remained a blessing for suffering humanity. Every person, whether of a strong or of a weak constitution, has a tendency towards a morbid craving for morphia, if from any disease he has become accustomed to injections of morphia, providing these injections were under his control; consequently, the morbid craving for morphia injections ranks amongst the other human passions, such as smoking, gambling, greediness for profits, sexual excesses, etc."

Quotations like these could be greatly extended, if it were necessary to rehearse the well-known evils of this obnoxious habit, or to show that at the present time, in other lands, the sure results of the excessive use of opium can be seen.

The resolve under which this article is prepared implies, that, if the sale of opium and the evils arising therefrom are increasing, the cause and manner thereof are to be investigated, and remedies proposed; but this investigation, whatever its conclusions, would not be complete without giving the cause of the large sales and extended use of opium, outside of that prescribed by physicians. There are many influences at work to introduce and spread the opium habit. Question No. 2, sent to physicians, asked, of those who thought that the use of opium was increasing, the cause of such increase. About one-third placed the blame wholly or in part upon the medical profession. Unfortunately, the opium *habitué* frequently gets his first acquaintance with the drug from its employment for the relief of pain; and, not knowing or realizing the evils arising therefrom, either continues it after the visits of his physician have ceased, or resorts to it for ills real or imaginary, without medical advice, and is a slave to it ere he is aware.

The following illustrates the peculiar power of opium. A medical gentleman of high standing, and years of practice in one of the cities of Massachusetts, recently told the writer of his experience with opium, after undergoing a painful sur-

gical operation. It was taken as a matter of course while the pain was severe, in lessening quantities as it subsided, and omitted on recovery; when the temptation to have the prescription refilled, and to continue its happy effects, was so great that it took a strong effort on his part to refrain from so doing. This illustrates also the evil of the unrestricted reduplication of prescriptions. The danger of continued use of the drug would have been many fold greater in the above case, if the subject had been ignorant of the nature of the remedy, and the terrible results of its use.

Dr. J. C. Wilson, in "College and Clinical Record," December, 1888, says: "The subject (opium habit) merits our most serious consideration, not only on account of the extent of the prevalence of these habits, and the disastrous consequences which they entail upon their individual victims and society at large, but also because the medical profession is to a great extent responsible for their existence. The extent to which we are individually responsible is perhaps slight; the extent to which we are responsible as a body is ernormous. We have become too familiar with the dangers of narcotics, which we thoroughly understand. Familiarity has bred, if not contempt, an easy-going indifference far more dangerous than contempt. The people, with that little knowledge which is proverbially dangerous, and doubly dangerous in medical matters, have grown familiar with narcotics without becoming aware of the risks that attend their use."

The opium evil is frequently spread by those who praise it as a remedy, the effects of which they know full well; and still further by those who simply recommend it as a reputed remedy for pain. DeQuincy tells us that he bought his first opium on the recommendation of a college acquaintance whom he met by accident. The readiness with which opium can be obtained from druggists without prescriptions, or by reduplication of them, forms not a small part of the cause of the large sales and use of the drug; while in part it must be ascribed to that desire for stimulation or sedation which seems to be the outcome of excessive brain work in the pursuit of earth's idols, — wealth and fame. Example serves not infrequently also, non-users becoming victims by

merely seeing an intimate friend or acquaintance indulge in the habit. The following are a few extracts from physicians' replies in relation to the cause of the extended use of opium: —

"I think that physicians are too ready to prescribe, and patients are too ready to take, morphia and other opiates for the relief of pain, without due regard to the readiness with which the opium habit is formed."

"Indiscreet and indiscriminate prescribing of the drug on the part of physicians; its very general employment in the composition of soothing syrups, and other patent remedies; the fact that public attention has been directed to this agent by numerous popular articles in magazines and newspapers."

"An increase in general nervous excitability, due to more luxurious modes of living in all classes during the last thirty years; added to this is the facility with which opium and other dangerous drugs may be obtained, upon the prescription of irresponsible practitioners."

"Habits of luxury and self-indulgence; increased mental and emotional strain in life; greater predominance of the neurotic or neuropathic temperament, and its accompanying craving for stimulants and neurotics; a desire for stimulation and intoxication which can be concealed."

"There are several causes, among which are over mental strain, and all conditions of life which produce insomnia; using it in place of alcoholic stimulants; the common use of the hypodermic syringe, and quack medicines."

"Disinclination of people to bear pain; carelessness on part of physicians, who prescribe opium in its various forms without further knowledge as to patient; continuance of drug; and free, unlicensed sale of opium."

"Fear that physicians are often responsible; prescriptions are given and patients have them filled *ad libitum.*'

Many remedies have been proposed for the evils of the opium habit, and undoubtedly they may be in part successfully applied. Great care on the part of physicians in the use of opium would be a powerful aid in this direction. The welfare and even safety of the patient may depend upon the medical attendant: whether he speaks lightly of the use of opium, and advises that a preparation be kept conveniently

near for use when it seems to be necessary; or shows in its true light the evils of its use, and, if the case demands it, leaves a preparation of the component parts of which the patient knows nothing, and can learn nothing. A just conservatism exists among educated medical men in the use of the drug, and it is probably true that a majority of them use less rather than more year by year, seeking other and less dangerous remedies for the relief of pain. Especially is this true in chronic diseases, in which there are many drugs that can be used instead of opium, while in acute painful diseases there is no substitute; but a wide difference exists in the liability of acquiring the opium habit from its use in these two classes of diseases, the danger being very small in acute troubles.

Of the many remedies suggested for the opium evil in the answers to the circulars, that of regulation of the sale received the most supporters. Evidently all others must prove ineffectual, unless the traffic is restricted to the utmost, consistent with the actual wants of the public. The following extracts from circular replies from physicians are of interest: —

"I think the sale of opium and its preparations should be regulated by a special law. However, I do not think that this would do much good unless enforced by a preponderating moral sentiment in the State."

"A law regulating the sale of the drug by wholesalers; a law forbidding druggists selling opium or any of its preparations without a physician's prescription."

"Stringent laws, forbidding the sale of opium without prescriptions by properly qualified physicians, and so guarded that one prescription shall not be used an indefinite number of times."

"Prohibiting the sale without a prescription would undoubtedly do some good. The broadcast circulation of a tract showing the evils of its use, and the absurdity of 'opium cures,' would do more."

"By making it a misdemeanor to sell the drug or any of its preparations without an original prescription given by a graduate in medicine."

"I believe much good might be done by enacting a law

that a physician's prescription of opium, or any mixture containing opium or its alkaloids, shall not be repeated by any druggist except by direction of the physician, an effective deterrent penalty being attached to violation of the statute."

"Either the removal of the victim from the opium, or the opium from the victim."

"Better public sentiment regarding all kinds of intoxication; better individual training in the schools, as well as at home; the same restriction of sale as in arsenic, etc."

"The enforcement of a law requiring that, on the sale of any substance composed totally or in part of a poison recognized as such by statute, the bottle, box or other receptacle containing such poison should distinctly indicate by label or otherwise the name and amount of the enclosed poison."

The following comes from a physician of years of practice, who has charge of one of the large asylums of the State: —

"I do not believe there ever was or ever will be a single remedy for the opium habit; that is, no drug alone can possibly cure the addiction. Among women, I find McMunn's elixir of opium the favorite form of the drug. Among infants, and in the early years of life, soothing syrups are the cause of untold misery; for seeds are doubtlessly sown in infancy only to bear the most pernicious fruit in adult life. It is said that one of the best-known so-called 'soothing syrups' contains from one to three grains of morphia to the ounce of simple syrup. I have known many instances where a bottle of this mixture has been given to an infant of a few months old in twenty-four hours. I believe that stringent legal measures should immediately be taken to stop the sale of so-called soothing syrups containing opium, morphia or codein."

These replies in regard to the use of opium, the cause and remedy for the evil, come from a well-known specialist in nervous diseases in New York City, and a physician of wide repute in Chicago: —

"Up to about five years ago, a rapid increase was noted; since then, I should say there was approaching a standstill, though there is a slight increase, most marked among native Americans."

"As to cause: (1) Increased number of persons indi-

rectly connecting themselves with the medical profession, and thus brought in contact with the drug, — nurses, masseurs, etc. (2) Neuroses, involving lack of 'soap.' (3) Attempts to relieve craving for other indulgences (alcohol). (4) Total-abstinence hypocrisy. (5) Proprietary drugs containing opium."

"Remedy: (1) Severe penalties for the addition of any narcotics to proprietary preparations. (2) Ditto for the sale of such to the laity. Up to very recently, 'Bromidia' containing (for a long period, as sold in New York) opium has produced several *habitués* in my experience. A larger number were due to the Scotch Oats Essence. (3) Inculcation of rational habits of thought, doing away with the 'all work and no play' principle."

"I think not any more than in proportion to the increase of population. I have had a large circle of practice in this city (Chicago) for forty years, and I do not think I meet with habitual users of any preparation of opium more frequently than I did thirty years since. If there is any increase, it has been from the introduction of the hypodermic syringe, and its use for morphine injections to allay pain and procure sleep. The magic quickness of the relief it affords has tempted many persons to become habitual users, much to their injury."

"Remedy: Induce medical men to be more cautious in using opiates in chronic diseases; and better educate the people."

Of seven replies to circulars sent to the superintendents of insane asylums in New England, and embracing at least one from each State, two believe that the use of opium is increasing, and five that it is not. Of the two who think that it is, one attributes such increase to injudicious use by physicians, the other to "bad living, nervous exhaustion, strain and drain."

Remedies: "It seems to me that intelligent prophylaxis can do more than anything else. The prognosis after the habit is once formed is grave. Relapses are common. The physician must be careful in his prescribing of the drug. I think that he should never teach a patient to use the subcutaneous syringe."

"Prohibiting sale to any but physicians, or to anyone without a freshly dated prescription for each and every purchase."

"The best moral remedy, in my opinion, would be an institution or hospital for the treatment of such cases, sanctioned by State laws, giving the management power to detain and treat until all habits have been reformed. This habit, when the subject has lost all will-power and self-control, is as much a disease as is mania or melancholia, and should be treated as such. Why should not the law protect such cases, and afford them proper restraint and treatment, as the State does its insane of another type?"

Dr. Levinstein says: "The successful study of prophylactic measures, for the sake of preventing the further spreading of morbid craving for morphia, is only to be carried on by energetic mutual action on the part of the medical practitioners, supported by the respective legal authorities. We shall not be wrong in saying that morbid craving for morphia, after the lapse of several years, will be of rare occurrence in Germany, as soon as the governmental decrees, already issued by some of the States, are obeyed; the doctors in future not allowing the morphia injections to be practised by anyone but themselves."

"There is, however, another way of preventing the spread of morbid craving for morphia, supporting at the same time the measures taken by the government, and the position of the medical profession; *i. e.*, the public instruction by popular writings on the part of the official authorities, after the manner carried out by the royal Prussian government on several other occasions. Thus it annually publishes a warning in the government organs and the daily papers, regarding the use of poisonous colors and materials; and it annually repeats the instructions, in order to prevent intoxication by oxide of carbon, through using stoves with hermetically closing doors, and without vent holes, etc. No official instructions have, up to the present time, been published regarding the dangers attendant upon the abuse of injections of morphia. As soon, however, as the educated public, who is mostly afflicted with morbid craving for morphia, has acquired a knowledge of the great extent of the

injury following the abuse of morphia, it will itself become, eventually, the guardian of its highest interests."

The following is taken from the October, 1888, number of the "Quarterly Review of Narcotic Inebriety:" —

"There are one or two prophylactic measures needed. More stringent laws should be enacted in most States in regard to the selling of narcotics, and especially of sulphate of morphia. They should only be sold on the prescription of some known physician, and never refilled. The use of the hypodermic syringe by the patient himself, or anyone except a regular physician, should be proscribed by legislative enactment. These are some of the points connected with narcotic inebriety, which the State is in duty bound to carefully consider. In some States the law requires a study in the common schools of the effects of narcotics on the human system."

Wilson, in the paper already referred to, says: —

"I believe that to point out the relation of the profession to the general subject of the abuse of narcotics, and to make clear the part played by medical men in the causation of such habits, would go far towards checking their spread."

"The dissemination of a wholesome knowledge of the methods by which the opium habit and kindred affections are induced, of the serious character of these affections, and of the dangers attendant upon an ignorant and careless employment of narcotics, would constitute an important measure of prophylaxis. I am fully aware of the evils resulting from the publication of sensational writings relating to these subjects. Nowithstanding these dangers, I am convinced that a reasonable and temperate presentation of the facts in the popular works upon hygiene, used in schools and in the family, would exercise a wholesome influence in restraining the tendency to the practice of these vices. Under such influences, example and suggestion would lose much of their force; and the evils necessarily attendant upon the prescription of narcotics in medicine would also be greatly diminished. The uniform and efficient regulation of the sale of narcotic drugs by law would constitute an important prophylactic measure against habitual narcotism."

Dr. J. M. Hull, in Iowa State Board of Health report,

1885, says, in relation to checking the spread of the opium habit: "I am strongly of the opinion, that, if done at all, it must be done at least in part by legislation. Physicians must be taught better than to use the drug in such a manner as to cause the habit to be formed; and, finally, the masses must be instructed with regard to the danger of a prolonged use of opiates, and especially the use of the hypodermic syringe."

This investigation shows that a large amount of opium and its preparations is sold, not on a physician's prescription, and to all classes, — those who know its evil effects, those who are ignorant of them, — for real and imaginary ills; sold openly, under its real name, and secretly as a quieting agent to those who know not and care not what they take. The opium habit is a form of inebriation. An editorial in the "Quarterly Review" states: "The effects of alcohol and opium upon the human system are almost identical. The primary action of alcohol is that of a stimulant, which in a few hours passes away; and if the quantity taken be small, the person will regain his normal condition, but if a large quantity be taken, he will soon experience the narcotic effect of the liquor. He is as completely narcotized as if he had taken a grain of morphia. Clinically, he presents the appearance of one narcotized with an opiate; and, pathologically, nearly the same tissue changes take place in the twin forms of inebriety."

Opium is used to some extent as a substitute for alcohol by those who feel the need of some form of stimulation or sedation, and choose this on account of price, convenience, or secret character; or, having experienced the soothing effects of the drug, have no desire or will-power to leave it off. Many of those do not know the evils arising from its use; others do not care, are unwilling to bear pain, and use it in increasing doses, or take it only occasionally, when necessity seems to demand it, and use it for years, apparently without deleterious effects.

Vincent Richards, in studying opium-eating in Asia Minor, estimates that one in twelve or fourteen of the population use it. He states that moderate use is the rule, excessive use the exception; that it is taken twice a day, A.M. and

P.M., the average daily amount being from five to seven grains, which is not increased when the dose is small, but when large it had been increased from its first use. He concludes that the excessive use of opium by agricultural classes is very rare indeed; and that its moderate use may be, and is, indulged in for years without producing decided ill effects, except weakening the reproductive powers. Dr. Dymock of Bombay concurs in the opinion as to moderate use; Dr. Moore's experience in Rajputana supports the same views. The moderate and daily use of opium is a form of inebriety not uncommon in Mohammedan countries, under ban imposed on the use of alcoholic beverages.

It is undoubtedly true that the continued use of alcohol and narcotic drugs is injurious, tends to shorten life and induce disease; it is also true that the recuperative power of the human frame is such, that any injurious effects are in part overcome when they are used regularly, in moderate and not increasing quantities. Experience shows, however, that with us, at least, the regular and moderate use of the former is the exception, the use of increasing quantities the rule; while with the latter, when once the baneful habit has been acquired, this is reversed. Then, again, the more secret character of the opium habit; its slower effects, but surer hold it has upon its victims; the greater liability to relapses after reformation; its peculiar effects upon the nerve centres, whereby the mental forces are enfeebled, the moral sense obtunded, and life itself shortened, — make it by far the more dangerous of the twin forms of inebriety.

Opium is the remedy par excellence for pain, and it must be used by physicians, and will be sold by druggists. The former cannot meet and battle disease successfully without it; the latter need not sell it, except to physicians, or on their order. The returns from druggists frequently showed that a little disapprobation on their part would serve to check their trade in opium except on prescription, and send it to others less careful in their sales. The seeds of the opium habit are sown by the thoughtless action of both physicians and druggists; and, unfortunately, it cannot be wholly remedied. The pharmacy law will give us a better class of dealers in the State; and, when this is coupled with a law

regulating the practice of medicine, so that only educated physicians shall be allowed to practice in the State, we shall not only have much less opium sold, but the moral effect of such legislation would be very great. Education and moral means are powerful aids in lessening the evil; and one way to bring this about is by legal measures. This itself would cause public agitation, and thus education. The enactment and enforcement of laws against the sale of alcoholic liquors have been the means of teaching the people the evils of dram-drinking, and all of the dangers of the intoxicating cup.

The introduction and free use of light wines, to satisfy the natural cravings for stimulation, have been suggested as one way of limiting the use of opium. The effects of this upon the use of the drug would be *nil;* besides, the substitution of one evil for another is a poor way to bring about reform in wrong-doing. The light wines are more generally used in France than in any civilized country.

J. C. Wilson says: "According to Jouet, whose assertions are corroborated by occasional statements in the French newspapers, the habitual injection of morphia is to-day, in France, at least, almost a matter of passion. Landowski states that friendship is occasionally pushed to the extent of exchanging pretty syringes in silver cases as presents; and a patient received upon his birthday a hypodermic syringe, as a gift from his sister."

The sale of soothing syrups and all medicine designed for the use of children, which contain opium and its preparations, should be prohibited. Whatever may be said in extenuation of its sale, without the advice of a physician, for use by adults, no one would advocate its use by the young. Especially is this so in regard to remedies the component parts of which are not known by the public. If opium must be given to children, let the well-known paregoric be the form; and the minimum harm, as far as they are concerned, will be the result. It is the secret remedy that is the most popular. Many would be deterred from using a preparation known to contain opium, who would use without question a soothing syrup recommended for teething children.

It is not surprising that opium in the form of soothing

syrups is so frequently found as part of the equipment of the nursery, when advertisements like the following are to be found in many of the daily and weekly papers:—

Advice to Mothers.

Mrs. ——— Soothing Syrup, for children teething, is the prescription of one of the best female nurses and physicians in the United States, and has been used for forty years with never-failing success by millions of mothers for their children. During the process of teething its value is incalculable. It relieves the child from pain, cures dysentery and diarrhœa, griping in the bowels, and wind colic. By giving health to the child, it rests the mother. Price, 25 cents a bottle.

Advice to Mothers.

Mrs. ——— Soothing Syrup should always be used for children teething. It soothes the child, softens the gums, allays all pain, cures wind colic, and is the best remedy for diarrhœa. Twenty-five cents a bottle.

This soothing syrup is one of those mentioned in the appendix, and contains morphine. We are assured, by those who are in a position to know, that opium-smoking is not increasing in Massachusetts, and has rather decreased since the passage of the law of 1885, attaching a penalty; still, it is prevalent, as witness the case in one of our colleges, and the more recent Pittsfield case. A bill is before the present Congress, to prohibit the importation of smoking-opium. This is not prepared in this country. The difficulty of getting the extract of opium for smoking, and the outfit necessary for its use; the readiness with which the other forms of opium can be obtained, the ease with which they can be carried and secretly taken; the fascination of the hypodermic syringe, — lead to the selection of other methods than smoking to appease the appetite, and obtain the desired stimulation.

By the enforcement of the Massachusetts law of 1885, and by prohibiting the importation of smoking-opium, the smoking habit can be limited. Our efforts to regulate and restrict the use of opium should therefore be directed against the other methods by which it is obtained and used.

New York, Rhode Island and Maine have laws regulating

the sale of opium, the former prohibiting the reduplication of prescriptions also. The following is the law relating to the latter: —

"No pharmacist, druggist, apothecary or other person shall refill more than once prescriptions containing opium or morphine, or preparations of either, in which the dose of opium shall exceed one-quarter grain, or morphine one-twentieth grain, except with the verbal or written order of a physician."

In referring briefly to the conclusions of this investigation, it may be stated that much more opium is imported and sold than is required by the legitimate demands of the public; that this is necessarily followed by evils, which, though they are not so wide-spread as to constitute a public calamity, still are of such extent and nature as to demand serious attention. The exact extent of the evils arising from the use of opium cannot be stated, but, while far more injurious to the individual, in its relation to the public it may safely be said to be less than that of alcohol.

The use of opium is not increasing in Massachusetts. In the large centres of population there may be a slight increase from year to year. It is here that excesses and crime of all kinds, if not increasing, are much more common than in less populous districts. The better knowledge of the uses and effects of the drug, by means of the greater intercommunication of the people; the many facilities for obtaining it; the general practice of writing prescriptions, followed by unrestrained reduplication of them; the excitement of business, leading to overwork and overtaxing of the mental powers, — are conditions which are favorable to the increased use of opium.

The opium habit being one of the recognized forms of inebriety, and from its secret character and baneful effects particularly liable to spread insidiously, to the great injury of the individual and the public, the sale and use of opium should be limited in every possible manner by legal measures. Unfortunately, laws are too apt to lack enforcement, and should have educated public opinion behind them. To this end the co-operation of the medical profession, the press, the pulpit, and the teacher's desk, should be sought as a

THE NUMBER AND DISTRIBUTION

OF

MICRO-ORGANISMS IN THE AIR OF THE BOSTON CITY HOSPITAL,

WITH SOME

CARBONIC ACID DETERMINATIONS.

By GREENLEAF R. TUCKER, S. B.

In compliance with a vote of the State Board of Health which was passed in March, 1888, the writer of the following paper was requested to make an investigation relative to the quality of the air of hospital wards, which should have for its special objects to determine the number and distribution of micro-organisms in the air of such wards; the causes which affect their number and distribution; and as far as possible to determine their character. A study of the germs themselves was soon found to be impracticable, and it was thought advisable to reserve this part of the subject for future investigation. Transfers of colonies from the air of the wards, to the number of about two hundred, have been made and preserved for this purpose. It is believed that these cultures will represent most of the forms habitually present in the air of these buildings.

The experiments to be described began in November, 1888, and were continued uninterruptedly for a period of three months. Some regret is felt that a portion of the work at least could not be conducted under the conditions of weather to be expected at that time of year. The winter was exceptionally mild, and the ground practically free from snow.

The investigation of indoor air began by taking samples in the afternoon, between two and three o'clock; the time being so chosen because the wards are then in their normal condition, only such work being done as the necessities of

the sick demand. On Monday, Tuesday, Thursday and Saturday of each week, friends of patients are admitted from two to three P.M., usually to the number of two to three hundred, and distribute themselves throughout the various wards, the number of visitors in each ward being often equal to the number of patients; this afforded opportunity to observe the effect upon the air of increased numbers of people, over those habitually present. It was found necessary to limit the number of experiments each day to five, including the outside air. The total number of wards being eighteen, four or five days elapsed before a return could be made to a given point; and the entire month was necessary to accumulate sufficient data for each ward, from which to draw conclusions.

During December, samples were taken mornings, generally between eight and ten o'clock, the wards at that time being in a more or less disturbed condition, — beds are made, floors swept, surgical dressings changed, and the general comfort of the patients attended to. By following this plan, two series of results were obtained, showing the condition of the air under quiet and disturbing influences. The month of January and part of February were devoted to special investigation, which the previous work had shown to be necessary.

Methods employed in the Quantitative Determination of Micro-organisms in the Air.

The introduction by Koch in 1881 of a solid-culture medium for the study of micro-organisms has resulted in methods by which we can determine with facility, and approximately, if not with accuracy, the number of micro-organisms in the air. Koch himself exposed plates coated with a solid nutrient gelatine, upon which aerial microbes settled, and could be counted after development. Hesse, however, was the first to apply this principle quantitatively to investigations of the air, and in 1883 published the well-known method bearing his name. Petrie, in Germany, and Frankland, in England, have proposed methods, which, while retaining the solid-culture medium of Koch, differ essentially from the method of Hesse and from each other, in detail. In this

country, also, some new methods of culture have been practised by the writer, in conjunction with Professor Sedgwick, in a series of investigations conducted at the Massachusetts Institute of Technology.*

Hesse's Method.

Hesse makes use of the fact previously ascertained, — that micro-organisms rapidly settle out in a quiet atmosphere. He employs a long glass tube of large bore, coated inside with sterilized nutrient gelatine. The tube is fastened to a photographic tripod in a horizontal position, and, by a suitable connection with two aspirator-bottles, a slow current of air (one litre in three minutes) is drawn through the tube. The germs are all supposed to settle out during the passage of the air through the tube, and remain fixed by the moist, solid gelatine, where they become visible after several days as isolated colonies.

Frankland's Method.

This method consists in aspirating a known volume of air through a glass tube containing two sterile plugs of glass-wool alone, or glass-wool and fine sugar-powder; after which the germ-laden filter is transferred to a flask containing melted sterilized nutrient gelatine, the two thoroughly shaken together, and solidified upon the sides of the flask by cooling, where the colonies which develop can be counted.

Petrie's Method.

Petrie uses fine sand as a filter, packed in a small glass tube, and held in place by disks of wire gauze. After drawing through sufficient air by means of an air pump, the sand, with its occluded germs, is poured into several small double dishes of glass, containing nutrient gelatine, the object being to distribute the sand and germs over a considerable surface, so that the colonies may be more readily counted.

The method employed in the present investigation was first used by the writer, in association with Professor Sedg-

* See foot-note on page 164.

wick,* in a series of experiments in 1887, and will be described somewhat in detail.

The actual requirements of a quantitative method for the bacteriological examination of air, briefly stated, are as follows: —

First. — A means of collecting and accurately measuring the volume of air to be examined.

Second. — A suitable filtering medium for holding back the micro-organisms contained in the air.

Third. — A solid-culture medium, in which the germ-laden filter can be diffused, and where, on cooling and incubating for a sufficient length of time, the germs may develop and be counted as isolated colonies.

The apparatus consists essentially of three parts: (1) A glass tube of special form, to which the name of *aerobioscope* has been given (see Fig. 1); (2) a stout copper cylinder of about sixteen litres capacity, provided with a vacuum gauge (see Fig. 2); (3) an air pump. The *aerobioscope* through which the air is aspirated is six inches long, and one and three-quarters inches in diameter at its expanded part; the upper end of it is narrowed somewhat to a neck one inch in diameter and one inch long. To the lower end is fused a piece of glass tubing six inches long and three-sixteenths of an inch in bore, in which to place the filtering material.

Preparation of the *aerobioscope*: Upon the narrow part of the tube, two inches from the lower end, a slight mark is made with a file, and a little roll of brass gauze is inserted, which serves as a stop for the filter to be placed above it. Beneath the gauze stop is placed a small plug of cotton wool, and the open ends are then plugged with cotton wool; the tube is now placed in a sterilizer, and subjected to a heat of at least 150° C. for one or two hours. When cool, the non-sterilized cotton-wool plug is carefully removed from the neck, and sterilized No. 50 granulated sugar is poured in, until it just fills the four inches of narrow tube above the gauze stop. This column of sugar weighs one gramme and is the filtering material employed to engage and retain the

* The complete paper was presented to the National Academy of Sciences at Washington, April 18, 1888, under the title "A new Method for the Biological Examination of Air: with a description of an Aerobioscope."


Sterilized Cotton Wool plug
Space for Culture
Etched Lines for Counting
Sterilized Granulated Sugar
Wire Gauze
Stop
Cotton Wool
Cotton wool plug
Ærobioscope

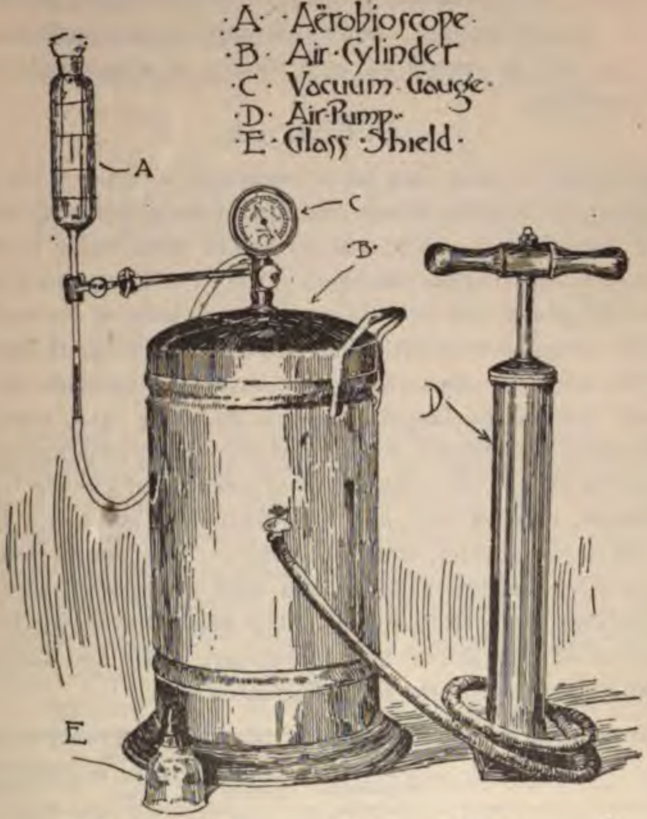
Fig. 1.

micro-organisms. The cotton-wool plug being replaced, the tube is again placed in the sterilizer, and re-sterilized for several hours at 120° C.

Taking the air sample: In order to measure the amount of air used, the value of each degree on the vacuum gauge is determined in terms of air, by means of an air meter, or by calculation from the known capacity of the cylinder. This fact ascertained, the negative pressure indicated by the needle on exhausting the cylinder shows the volume of air which must pass into it to fill the vacuum. By means of the air pump, one exhausts the cylinder until the needle reaches the mark corresponding to the amount of air required. A sterilized *aerobioscope* is attached to the cylinder, in an upright position, by means of a clamp; and, to establish communication between the two, they are joined together by means of a rubber tube attached to the lower end of the *aerobioscope* and to a stop-cock on the cylinder. For removing and protecting the sterilized cotton-wool plug while the air is being drawn through the tube, a very simple device is used. A glass shield with a neck slightly larger than the neck of the *aerobioscope*, and bearing a rubber finger-cot, is pushed down over the cotton-wool plug; when, by compressing the rubber, the plug can be removed (inside the shield), and remains suspended there. The plug removed, the cock is opened, when air will pass through the *aerobioscope*, leaving its germs in the sterilized sugar filter.

Cultivation of the germs: The *aerobioscope*, after the air has been drawn through, is taken to the culture room for further treatment. The tube being held in a nearly horizontal position, the sugar (with the contained germs) is made to run into the body of the tube, by a gentle tapping. Melted sterilized nutrient gelatine (25 cc.) is now added, under proper precautions, and the neck closed with a perforated sterilized rubber stopper, plugged with cotton wool. On rotating the tube, the sugar all dissolves in the gelatine, leaving the germs uniformly distributed through it. The gelatine is now congealed in an even film upon the inside of the tube, where, after four or five days, the colonies will develop, and can be counted by the aid of squares engraved upon the glass.

The following cut shows the apparatus set up ready for use : —



·Apparatus·for·the·quantitative·determination·
·of·Micro-organisms·in·air·

Fig. 2.

This method has several advantages not to be found in other methods. In the first place, the use of a vacuous cylinder permits a known volume of air to be aspirated with great ease, and the rate of flow through the filter is controlled to a nicety. The advantage of a soluble filter (sterilized granulated sugar), leaving only the germs imbedded in the gelatine, cannot be overestimated; for any insoluble substances seriously interfere with the counting. Again, the

aerobioscope, quite apart from the filter, constitutes an important advance, since it obviates the necessity of transferring the filter (and contained germs), thereby avoiding accidental loss or gain of germs. The whole apparatus is portable, and the method, as compared with others, is exceedingly rapid of execution.

OUTSIDE AIR.

In order to have data for comparison with the work done indoors, the outside air was examined nearly every day during this investigation. The results are of some value in themselves, as showing the condition of the air of Boston in a rather secluded place, but in the immediate vicinity of its traffic.

The samples were all taken at the same place, at the foot of the surgical steps, four feet from the ground, on the north side of the hospital, except on rainy days, when the apparatus was moved under the steps, to avoid annoyance from the rain. The direction and strength of the wind, temperature, time of day, and any disturbing influences likely to affect the results, were observed. The ground was free from snow and the weather was mild throughout, while the prevailing winds were strong. The general averages for the months of November and December, 1888, and January, 1889, are shown in the following table: —

DATE.	Number of Experiments.	Average number of Bacteria.	Average number of Moulds.	Ratio of Bacteria to Moulds.
November, 1888, . .	19	10.4	6.8	1.5
December, 1888, . .	22	14.5	5.6	2.6
January, 1889, . .	15	13.2	3.5	3.8

All figures representing bacteria and moulds are for 10 litres of air.

The average number of bacteria are thus seen to be about the same for the three months, and representing, as they do, less than two per litre of air, must be considered small. Carnelly (Phil. Trans. of the Royal Society of London, vol. 178) found recently in the town of Dundee, in quiet places, as a mean of fourteen experiments, less than one bacterium per litre of air; while, in certain streets where the ratio of

bacteria to moulds was very high, the total number of organisms was 17.5 per litre of air.

A comparison between the numbers of organisms found on clear and on rainy days is shown in the next table: —

Condition of Weather.	November.			December.			January.		
	Number of Determinations.	Average Number of Bacteria.	Average Number of Moulds.	Number of Determinations.	Average Number of Bacteria.	Average Number of Moulds.	Number of Determinations.	Average Number of Bacteria.	Average Number of Moulds.
Rain, .	5	7.6	7.8	3	9.3	6.3	2	2.5	3
Clear, .	14	11.4	6.4	18	15.0	5.4	9	19.0	3.5

The number of bacteria present in the air on clear days is greater than on rainy days, but the number of moulds remains the same; *i. e.*, rain washes out bacteria from the air, but does not remove moulds. Both bacteria and moulds were more numerous on rainy days than was expected; and this is perhaps accounted for by the fact that the experiments were made under some stone steps, near a basement door frequently opened by employees.

No deductions could be drawn from the effect of the direction of the wind upon the micro-organisms, owing to the position of the buildings. The quarter from which the wind blew was taken from a neighboring weather-vane; but the direction, as felt by the observer, seldom coincided, being generally either easterly or westerly. The effect of the strength of the wind is, however, worthy of notice, being to increase the numbers of bacteria.

	November.			December.			January.		
	Number of Determinations.	Bacteria.	Moulds.	Number of Determinations.	Bacteria.	Moulds.	Number of Determinations.	Bacteria.	Moulds.
Wind slight, .	2	2.5	18.0	6	12	9.3	2	4.5	3
Wind strong, .	15	11.0	4.3	15	15	4.4	10	17.0	4

The following table gives the full data for all determinations made upon outside air during the month of December, 1888. It shows considerable variation from day to day, not readily accounted for by the surrounding conditions. The disturbing influences incident to a great city are so many, that causes affecting the numbers of micro-organisms in outside air are generally beyond the eye of the observer.

Outside Air. December, 1888.

Date.	Time.	Bacteria.	Moulds.	Remarks.
1	12.45 P.M.	1	5	Wind W., and moderate; almost raining.
3	11.15 A.M.	8	2	Wind W.; clear and cool.
5	10.00 "	0	7	Wind S. W., and gentle; sky overcast; ground damp.
6	11.00 "	75	5	Wind N. W., and strong; cloudy, cool; two teams drove by; considerable walking about.
7	11.25 "	57	8	Wind W.; strong and puffy; clear and cool.
8	11.30 "	1	2	Wind S. W.; moderate.
10	10.35 "	8	33	Wind S. E., and moderate; ground wet.
11	11.10 "	4	3	Wind E., and strong; raining hard.
13	11.45 "	19	3	Wind W., and strong; cold and quiet.
14	9.15 "	17	1	Wind W., and strong; cold and quiet.
15	11.00 "	12	6	Wind W., moderate; cold and quiet.
17	11.30 "	21	13	Wind S., and gentle; raining hard.
18	12.00 M.	3	3	Wind N. W., and strong; snowing a little; ground wet.
20	10.00 A.M.	7	3	Wind N. W., and moderate; cold.
21	–	24	10	Wind S. W., and gentle; sky overcast; quiet.
22	11.35 "	1	2	Wind N. W., and strong; cold; quiet.
24	11.40 "	14	14	Wind S. W., and gentle; very quiet.
25	1.00 P.M.	10	3	Wind S. W., and gentle.
26	11.30 A.M.	3	17	Wind S., and gentle; ground moist; warm.
27	9 50 "	14	6	Wind N. W., and gentle; ground wet.
29	10.15 "	2	1	Wind S. W., and strong; cool and quiet.
31	11.25 "	13	6	Wind S. W., and moderate but puffy; ground moist.
Average, . .		14.5	5.6	

General Description of the Hospital (with Plates).*

The group of buildings which constitute the Boston City Hospital are thirteen in number, nine of which are exclusively devoted to the sick. The hospital is on Harrison Avenue (see plate), and occupies about 292,000 square feet of land. Buildings to the right of the administration building are devoted to the treatment of medical cases, while those to the left are wholly devoted to surgical cases. The two pavilions, medical and surgical, nearest the street (see cut of hospital), are substantially alike in construction. The upper and lower floors are occupied by male patients,

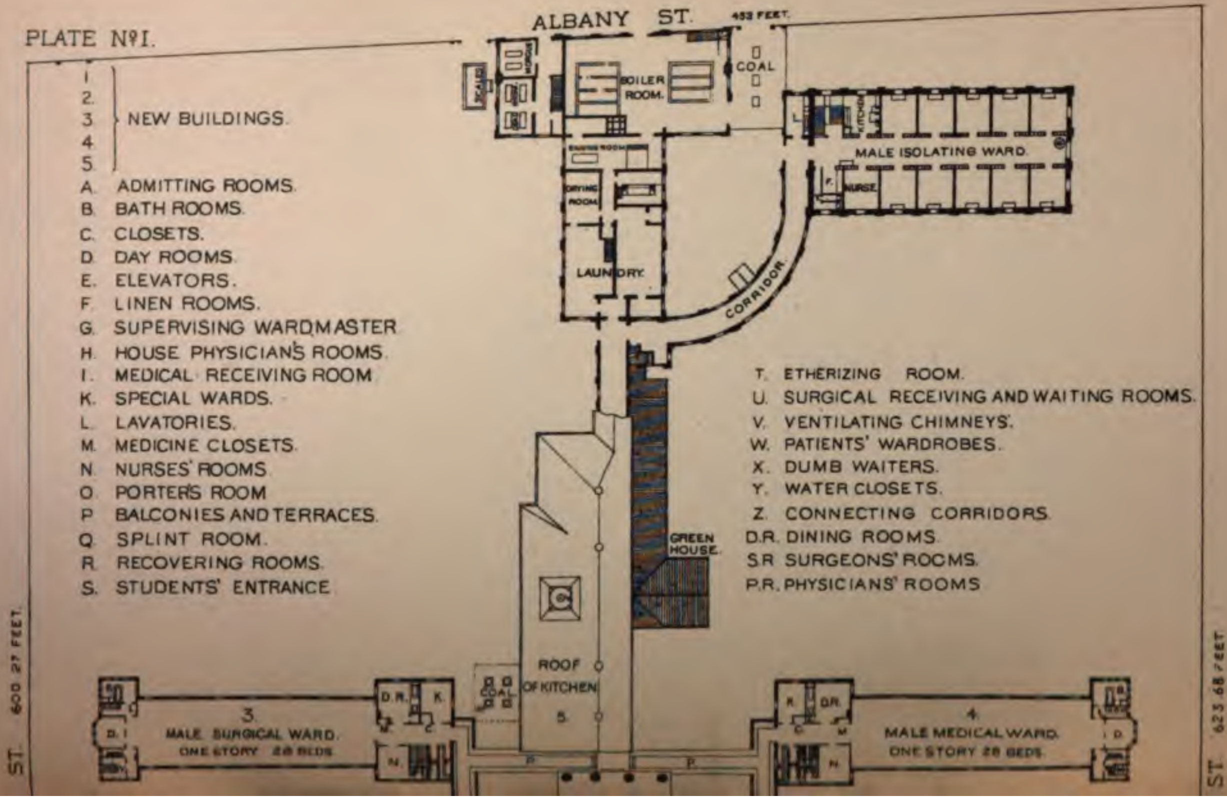
* The descriptions of the hospital appearing in this paper have been taken from the medical and surgical reports of the Boston City Hospital, second series.

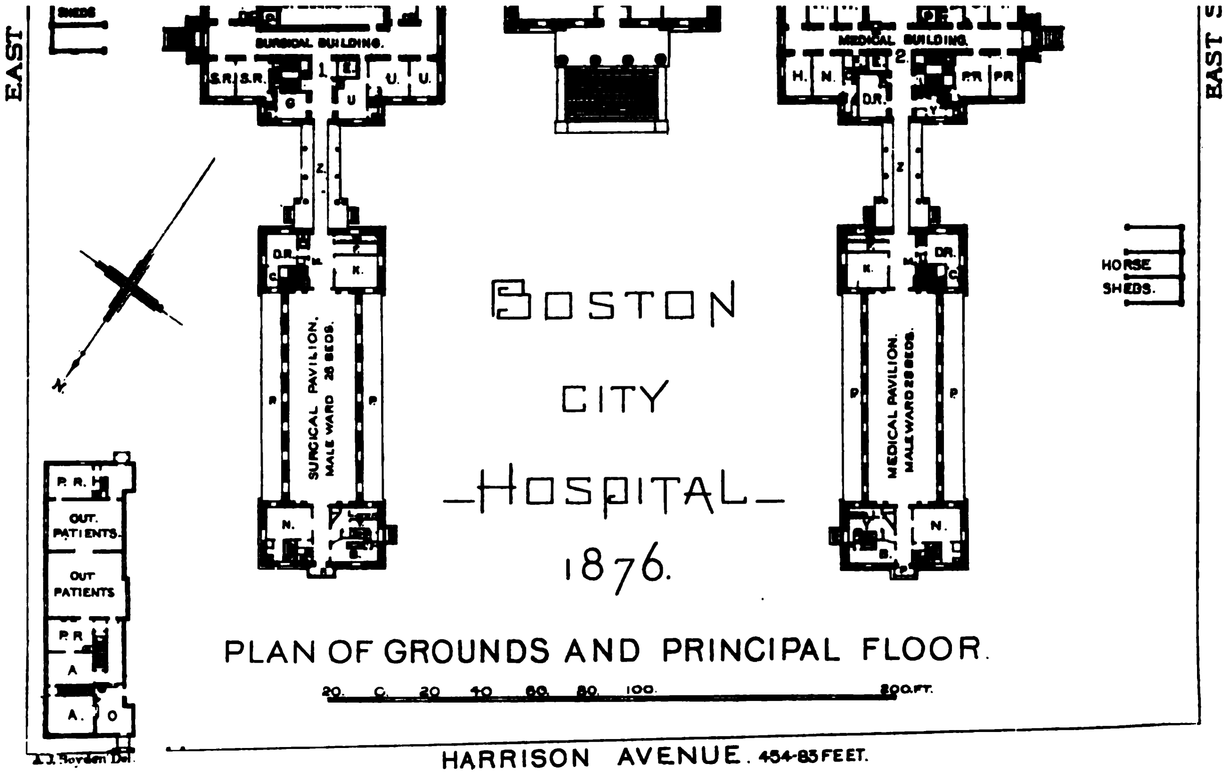
Wards B. C. D. Wards M. N. O. ADMINISTRATION Wards Q. R. S. Wards F. G. H.

BOSTON CITY HOSPITAL.

HELIOTYPE PRINTING CO., BOSTON.

PLATE No. I.


ALBANY ST.
453 FEET.
1
2
3 NEW BUILDINGS.
4
5
A. ADMITTING ROOMS.
B. BATH ROOMS.
C. CLOSETS.
D. DAY ROOMS.
E. ELEVATORS.
F. LINEN ROOMS.
G. SUPERVISING WARDMASTER.
H. HOUSE PHYSICIAN'S ROOMS.
I. MEDICAL RECEIVING ROOM.
K. SPECIAL WARDS.
L. LAVATORIES.
M. MEDICINE CLOSETS.
N. NURSES' ROOMS.
O. PORTER'S ROOM.
P. BALCONIES AND TERRACES.
Q. SPLINT ROOM.
R. RECOVERING ROOMS.
S. STUDENTS' ENTRANCE.
T. ETHERIZING ROOM.
U. SURGICAL RECEIVING AND WAITING ROOMS.
V. VENTILATING CHIMNEYS.
W. PATIENTS' WARDROBES.
X. DUMB WAITERS.
Y. WATER CLOSETS.
Z. CONNECTING CORRIDORS.
D.R. DINING ROOMS.
S.R. SURGEONS' ROOMS.
P.R. PHYSICIANS' ROOMS.
BOILER ROOM.
COAL
LAUNDRY.
DRYING ROOM
MALE ISOLATING WARD.
KITCHEN
NURSE
CORRIDOR.
GREEN HOUSE.
ROOF OF KITCHEN
5.
3.
MALE SURGICAL WARD.
ONE STORY 28 BEDS
4.
MALE MEDICAL WARD.
ONE STORY 28 BEDS
ST. 600 27 FEET.
ST. 623 68 FEET.


EAST
SHEDS
SURGICAL BUILDING.
S.R.
S.R.
1.
E.
U.
U.
G
U
Z.
D.R.
K.
C
SURGICAL PAVILION.
MALE WARD 28 BEDS.
P
P
N.
B.
MEDICAL BUILDING.
2.
H.
N.
E.
P.R.
P.R.
D.R.
Y.
Z
K.
D.R.
C
MEDICAL PAVILION.
MALE WARD 28 BEDS.
P
P
N.
B.
HORSE
SHEDS.
EAST S
BOSTON
CITY
HOSPITAL
1876.
N.
P. R. H.
OUT.
PATIENTS.
OUT
PATIENTS
P. R.
A
A.
O
PLAN OF GROUNDS AND PRINCIPAL FLOOR.
20. 0. 20 40 60 80 100. 200 FT.
HARRISON AVENUE. 454-83 FEET.
A. J. Boyden Del.

the middle floor by females. The pavilions immediately in the rear of the above are also medical and surgical. (Plans of other buildings, not seen in the cut, may be seen in plate No. I.) Pavilions 3 and 4 are one-story buildings. These wards are for male patients only, and contain twenty-eight beds. A two-story brick pavilion contains the male and female isolating wards. There are ten rooms on each floor, opening from a hall or passage way, and designed to accommodate one or more patients. The vacant space between the isolating wards and male medical ward 4 (plate No. I.) is now occupied by two new buildings for contagious diseases. They are totally different from all others of the group, but are themselves essentially alike. Diphtheria and scarlet-fever are at present treated in these wards.

The hospital receives mainly acute cases, with only such chronic cases as the authorities believe can be benefited by a short residence in the hospital. The hospital report for the year 1888 shows the number of patients admitted during the year to be 5,875; of this number, 3,665 were males, 2,210 females; 2,445 were born in the United States, the nativity of the remaining number being divided between thirty-five countries, representing all parts of the globe. The character of the diseases treated in the wards of this hospital, in the course of a year, embraces nearly all known to medical science.

The first two buildings to be described are shown in plate No. I., where they are designated surgical and medical pavilions. A plan of the second and third floors is shown in plates Nos. II. and III. Each pavilion is 148 feet in length, 48 feet in width, and three stories high. On the first, second and third floors are wards, each 80 feet long, $27\frac{2}{3}$ feet wide, the two lower being 16 feet, and the upper 10 feet high. Each ward is lighted by fourteen windows, seven on a side, and is arranged for twenty-eight beds. By considering the data of the two buildings together, we shall have not only a comparison of the wards of each pavilion, but of the two buildings themselves, devoted to two distinct classes of patients, — medical and surgical. In every other way the conditions found in these buildings are identical. The following tables give the average number of

micro-organisms, of five or more determinations in each ward: —

Medical Pavilion.

Afternoons, November, 1888.				Forenoons, December, 1888.			
	Wards.				Wards.		
	F.	G.	H.		F.	G.	H.
Bacteria, . .	15.8	13.0	33.3	Bacteria, . .	15.2	49.7	62.5
Moulds, . .	9.2	9.0	13.2	Moulds, . .	1.5	1.3	5.2

Surgical Pavilion.

Afternoons, November, 1888.				Forenoons, December, 1888.			
	Wards.				Wards.		
	B.	C.	D.		B.	C.	D.
Bacteria, . .	6.8	5.6	13.0	Bacteria, . .	24.7	15.8	16.5
Moulds, . .	6.6	2.8	8.2	Moulds, . .	13.5	20.0	26.5

The table shows the following results: —

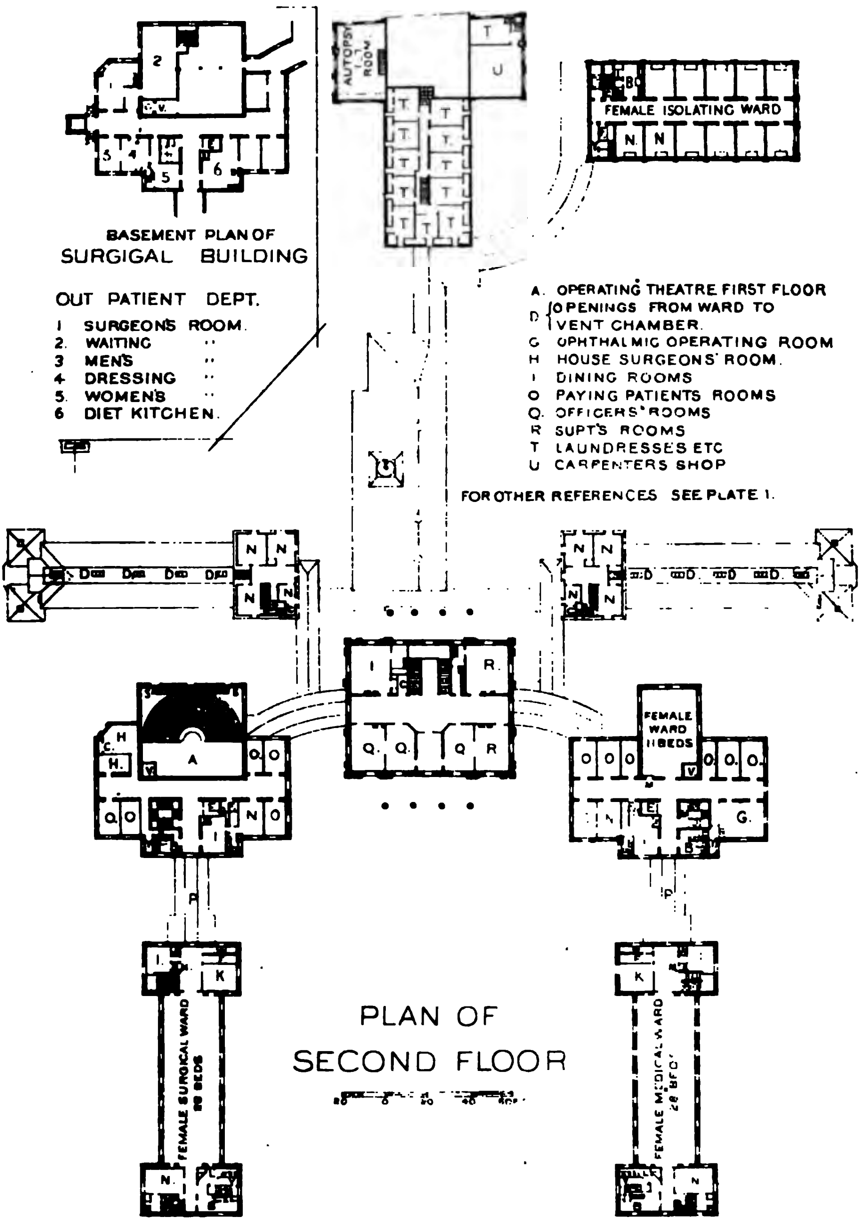
I. — Bacteria are more abundant in the medical than in the surgical pavilion.

This appears to me to be a very important and significant fact. Here are two buildings exactly alike, all the conditions within being the same, except that in one are medical, in the other surgical, patients. If the organisms come entirely from the outside air, there is no reason why both buildings should not contain practically the same numbers. It seems probable, therefore, that a portion at least of the bacteria found in the medical wards is due to the class of diseases assigned to them.

II. — Bacteria in both medical and surgical wards are more abundant mornings than afternoons.

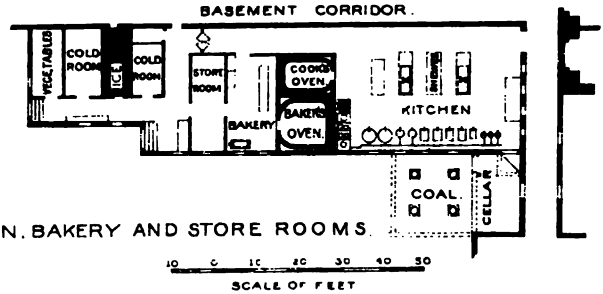
This is due to the conditions of the wards at the time of experiments. In the morning the disturbing influences are many, — bed-making, sweeping, dusting, changing of surgical dressings, toilet and general care of patients. Such

PLATE No 2



PLAN OF
SECOND FLOOR

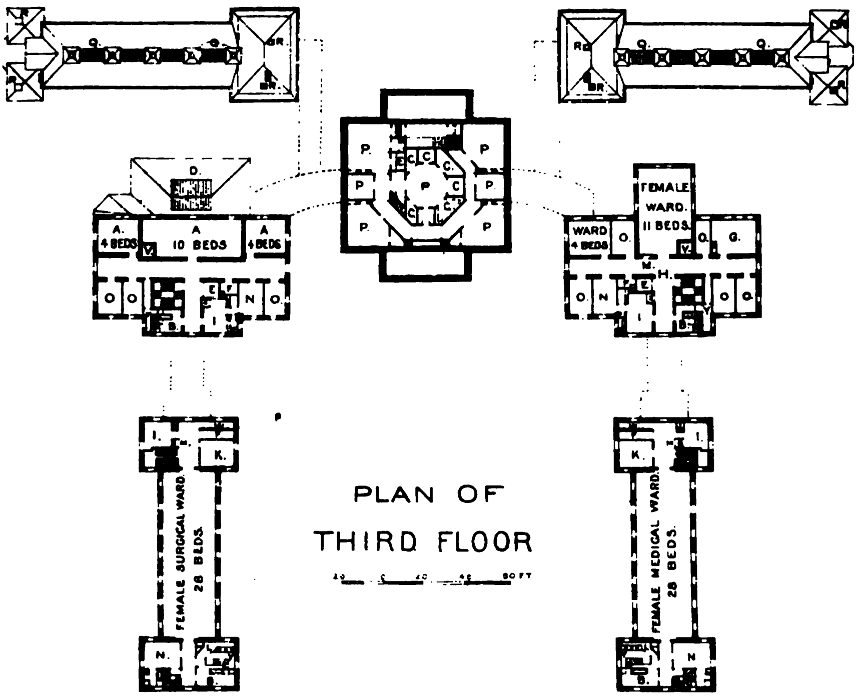
PLATE No. 3.



KITCHEN. BAKERY AND STORE ROOMS.

A CHILDREN'S WARDS
D SKYLIGHT OVER OPERATING THEATRE.
G OPERATING ROOM
H WARDS AND ROOMS FOR DISEASES OF WOMEN.
O PAYING PATIENTS' ROOM.
P CHAMBERS.
Q GLAZED ROOF OF VENT. CHAMBER.
R VENTILATORS.

FOR OTHER REFERENCES SEE PLATE No. 1.



PLAN OF THIRD FLOOR

work occupies the time between seven and ten A.M., at which time morning samples were taken. This general disturbance of the morning distributes the organisms throughout the air, where we find them in increased numbers; while in the afternoon a sufficient time has elapsed for many of them to settle out again.

III. — In the afternoon micro-organisms are most abundant in the upper wards, H and D, of each pavilion.

Ward H in the medical and D in the surgical pavilion are seen to be higher in micro-organisms in the afternoon than the other wards. There are two reasons for this: First, cubic space; second, unusual disturbance by patients. The cubic space per bed for the lower ward is 1,265 cubic feet; for the upper ward, 790 cubic feet. This comes from the difference in height, — 16 feet for the lower wards, against 10 feet for the upper wards. The unusual disturbance alluded to in these wards consists in a greater amount of walking about. There are fewer helpless cases, and consequently a larger proportion are up and about the wards. So much movement in a ward keeps the micro-organisms more completely in suspension, so that large numbers are more uniformly found throughout the afternoon than in more quiet wards with greater cubic space.

IV. — Female wards C and G contain less micro-organisms than the male wards.

There is far less commotion in a female than in a male ward, women being much more quiet than men. Such patients as are able to be up, remain, as a rule, sitting quietly by their bedsides, so that the fewer number of micro-organisms in the air of a female ward is quite what we should expect.

Medical and Surgical Pavilions, Nos. 1 and 2.

The next buildings to be considered, taking them in order of plan (plate No. I.), are the medical and surgical buildings, numbered 1 and 2. Their general dimensions are 24 feet by 94 feet, the height being the same as those just described. A projection from the rear wall of the medical pavilion gives a

small ward of eleven beds on each floor, the remaining space being divided into rooms of various sizes, opening from a central corridor, and devoted principally to paying patients, both male and female. The open wards are devoted exclusively to women, the lower ward being for convalescent patients. The lower ward, M, of the surgical pavilion, contains the operating amphitheatre and the accident rooms, and is entirely devoted to the demands of operative surgery. The middle floor, ward N, is exclusively a private ward, for both men and women. The upper floor, ward O, is the children's ward, and, in addition to three small wards, it has a number of private rooms for adults.

Owing to the distribution of floor space, and the purposes to which these buildings are devoted, the results obtained in them are not comparable with those in the two buildings just described. The wards (Q, R, S) on each floor of the medical building correspond closely with each other, but not with the wards (M, N, O) of the surgical building.

Below are the tables of averages for each ward, all results being the mean of five determinations. Morning samples were taken between ten and eleven A.M.; afternoon samples, between two and four P.M.

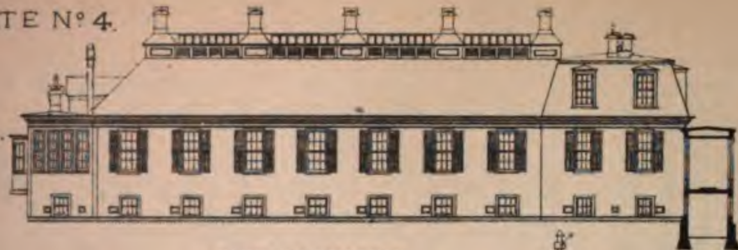
Medical Pavilion.

Afternoons, November, 1888.				Forenoons, December, 1888.			
	Female Wards.				Female Wards.		
	Q.	R.	S.		Q.	R.	S.
Bacteria, . .	8.6	9.8	8.8	Bacteria, . .	9.6	13.5	5.4
Moulds, . .	8.2	9.8	13.0	Moulds, . .	7.4	9.8	19.6

Surgical Pavilion.

Afternoons, November, 1888.				Forenoons, December, 1888.			
	Wards.				Wards.		
	M.	N.	O.		M.	N.	O.
Bacteria, . .	13.3	2.5	13.5	Bacteria, . .	14.6	18.2	15.3
Moulds, . .	9.3	11.0	19.0	Moulds, . .	15.0	7.0	26.5

PLATE No. 4.



SIDE ELEVATION
FIG. I.

FIG. 2 REAR.

FIG. 3

PLAN OF BATH ROOM AND W. CLOSETS.

C. SITZ BATH. STEAM BATH. SHOWER BATH.
D. VENT SHAFT. SLOP SINK. URINAL.
E. LOBBY.

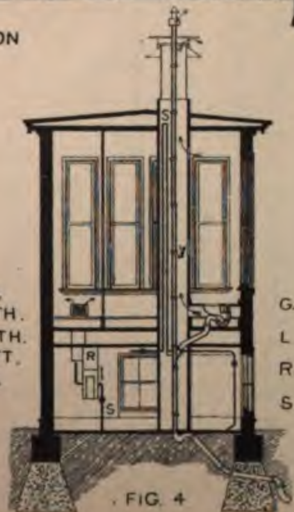
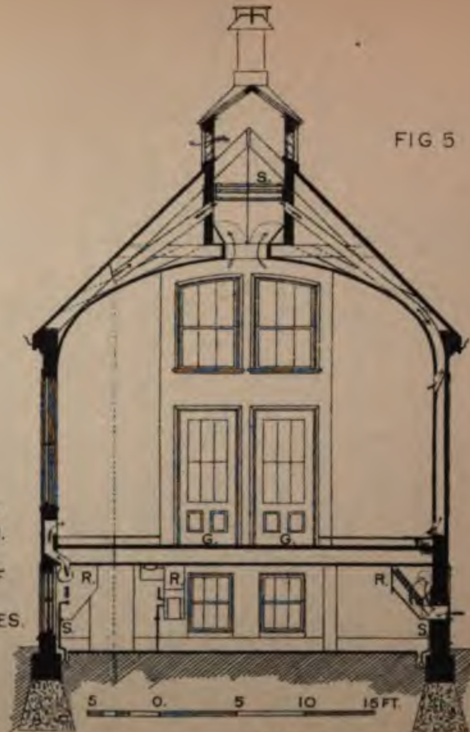


FIG. 4

SECTION ON LINE A.B
VENT. OF W. CLOSETS

G. DOORS TO DAY ROOM.
L. LAVATORY.
R. CASING OF RADIATOR.
S. STEAM PIPES.

FIG 5



PARTIAL SECTION THROUGH WINDOW.

PARTIAL TRANSVERSE SECTION BETWEEN WINDOWS.

DETAIL OF HEATING AND VENTILATING.

These tables do not show the striking differences seen in the larger medical and surgical buildings.

Medical Pavilion. — In this building the numbers found are very small, and are practically alike for bacteria and moulds. The determinations made in the morning do not materially differ from those made in the afternoon. The finding of small numbers of micro-organisms in the air of a ward during the forenoon is the best proof we can have of the absence of germs from the room itself.

Surgical Pavilion. — In the afternoon the wards of the surgical building agree in the number of bacteria found, excepting in ward N. Ward O was more abundant in moulds, both forenoon and afternoon, than the other wards; and this is true of ward S, the corresponding ward of the medical building During the month of November, ward N was closed, and the samples were all taken with the ward empty, and very quiet. The average number of bacteria found at this time was 2.5 per 10 litres of air; but in December, with two patients and one nurse present, the number of bacteria was 18.2.

One-story Medical and Surgical Pavilions, Wards T and P.

The one-story buildings are shown in plan in plate No. I., where they are numbered 3 and 4; and a section and elevation of the surgical pavilion are shown in plate No. IV. The two buildings are alike in form and arrangement. The ward is 94 feet long, by 26½ feet wide, and has seven opposite windows and fourteen beds on a side; the windows, having double sashes, are 9 feet high by 4 feet wide. The height of the ward, from the floor to the centre of the arched ceiling, is 22 feet, or an average of about 19 feet. The floor area for each bed is 89 square feet, and the air space about 1,700 cubic feet. The basement is an open and free air space, containing only heating apparatus. The floor is made hard and impenetrable to moisture by concrete and cement, and is on a level with the ground outside. Its numerous windows can be left open many months in the year; and, its doors being locked, it is cleanly and free from any intrusion.

The method of heating and ventilating these buildings is

shown in plate No. IV., fig. 5. The air enters the ward only through inlets under each window, fourteen in all. The foul air escapes through five large openings along the centre of the arched ceiling, each 3 feet by 6 feet, into a ridge chamber, and thence either through the free openings in the sides of the chamber above the roof, or through five ventilators, each 2 feet in diameter, on the top of the ridge.

It has been found, by air-meter tests, that the whole volume of air in the wards, about 47,600 cubic feet, or 1,700 cubic feet per patient, is changed between three and four times hourly.

A consideration of the number of micro-organisms found in these wards is particularly interesting, as they represent the modern ideas of hospital construction. The system of heating and ventilation is regarded as excellent, and they are considered model wards, in all respects. The following table shows the average number of micro-organisms found in both wards, forenoon and afternoon: —

Ward P (Surgical, Male). Samples taken Afternoons, November, 1888.

Date.	Time.	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
Nov. 3,	4.25	60	27	23	12	Some walking about.
" 9,	3.10	70	28	25	35	Close smell.
" 15,	2.10	70	-	9	2	Fifteen visitors present.
" 20,	-	64	25	12	15	Twenty-two visitors present; ward quiet.
" 30,	3.00	65	31	12	6	Considerable walking about.
Average, ...				16.2	14	

Ward P (Surgical, Male). Samples taken Mornings, December, 1888.

Date.	Time.	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
Dec. 3,	11.00	70	31	6	0	Ward quiet.
" 7,	10.45	66	28	21	7	Surgeon's visit, with fourteen students.
" 24,	11.15	72	25	5	14	Ward quiet.
Average, ...				10.6	7	

Ward T (Medical, Male). Samples taken Afternoons, November, 1888.

Date.	Time.	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
Nov. 3,	4.15	68	27	13	0	Windows closed.
" 9,	3.00	70	25	11	20	End door open; some walking about.
" 15,	2.30	70	-	9	4	Fourteen visitors present; ward quiet.
" 20,	3.00	65	16	6	7	Sixteen visitors present.
" 30,	2.40	63	25	19	7	Changed some bedding.
Average,				11.6	7.6	

Ward T (Medical, Male). Samples taken Mornings, December, 1888. and January, 1889.

Date.	Time.	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
Dec. 8,	11.15	69	25	22	9	Mopping floor.
" 13,	11.25	64	26	29	4	Ward quiet.
" 24,	11.10	68	24	8	1	Mopping floor.
Jan. 2,	-	-	-	26	15	
Average,				21.3	9.5	

No high numbers appear in any of the determinations, either forenoon or afternoon. In ward T the bacteria found in the forenoon are about twice the number found in the afternoon, while the moulds are about the same. In ward P, on the contrary, both bacteria and moulds are highest in the afternoon. This is perhaps due to the fact that the determinations that were made in the morning occurred too late to be affected by the general disturbance of ward work.

During the morning of December 7, ward P was visited by the surgeon and fourteen students, all moving about from bed to bed. The number of bacteria found was but 21. Again, on the four afternoons when visitors were present, in both wards P and T, the number of bacteria was less than it was on other days. With wards in good order, it seems to be true for all, that the presence of visitors does not as a rule increase the number of micro-organisms. The large cubic

space, excellent ventilation, and perfect cleanliness of these buildings, is sufficient to account for their freedom from micro-organisms.

Isolating Wards, K and L.

A two-story brick building, located near the southern corner of the grounds, contains the male and female isolating wards, which are shown in plates I. and II. The building is 101½ feet long, and 46½ feet wide, with a basement or cellar underneath, which brings the first floor to a height of about two feet above the ground level. There is a ventilating chamber on the roof, 10 feet wide, extending the whole length of the building. A hall or passage way, 10 feet wide, divides each story, with rooms on either side, and windows at each end, excepting at the entrance door on the first floor. There are ten rooms on each floor, 14 feet by 15 feet in size, and designed to accommodate from one to four patients in each. The rooms on the first floor, for male patients, are 14 feet high; and those on the second floor, for females, are 18 feet high. The fresh-air supply is admitted through openings in the outer wall under the windows, and near the floor in each. A steam radiator is placed in front of these openings, and surrounded by a casing of wood lined with tin, having a register in front. A simple arrangement of sliding valves within the casing controls the temperature and volume of the entering air. The air of these rooms is believed to be changed from three to four times hourly.

The service of these wards is the most arduous of any connected with the hospital. For many years they furnished the only available place for the treatment of contagious diseases, as well as a class of cases which, by reason of uncleanliness, delirium, etc., were not fit to remain in an open ward. During the summer of 1888 they were vacated, and thoroughly renovated. The opening of the new wards for contagious diseases has removed the necessity of treating such cases here. At present there are treated in these wards, alcoholismus, alcoholic pneumonia, erysipelas, rheumatism, typhoid fever, and many unclean medical and surgical cases.

The above facts are mentioned because it was thought that these wards would furnish a larger number of micro-organisms than other parts of the hospital.

Of the tables of determinations representing the work done in this building, the following show the average results for morning and afternoon, in the corridor of each ward; while the others show the condition of the rooms themselves. All determinations made in the rooms of each ward were made on the same day, each determination following the other in succession. The number of micro-organisms found in ward K corridor in the afternoon is surprisingly small; and even in the morning, when there was considerable walking about by nurses and patients, the numbers found were also small. Moulds appear from the table to abound in ward L. The bacteria were few in number both forenoon and afternoon.

Ward K (Male), Isolating Ward. Samples taken Afternoons.

Date.	Time.	Temperature, Degrees.	Bacteria.	Moulds.	Remarks.
Nov. 2,	-	71	3	6	End door and window open; considerable draught; floor unclean; some walking about.
" 10,	2.25	66	11	5	End window open; draught; considerable walking about.
" 16,	2.50	68	0	17	End door and window open; considerable draught.
" 21,	3.00	65	1	4	End window open; some walking about.
Average, . . .			3.6	6.2	

Ward K (Male,) Isolating Ward. Samples taken Mornings.

Date.	Time.	Temperature, Degrees.	Bacteria.	Moulds.	Remarks.
Dec. 1,	12.00	59	10	8	Corridor door open; cool draught; patients walking about; floor unclean.
" 11,	11.30	64	13	28	End door and window open; draught; some walking about.
" 17,	10.25	66	7	1	End door and window open; considerable walking about.
" 26,	12.00	64	18	6	Floor just previously swept; end door and window open.
Average, . . .			12	10.8	

Ward L (Female), Isolating Ward. Samples taken Afternoons.

Date.	Time.	Temperature, Degrees.	Bacteria.	Moulds.	Remarks.
Nov. 2,	-	72	10	8	End window open; considerable draught.
" 10,	2.10	67	23	8	Visitors' day; ward previously swept.
" 16,	2.35	70	5	67	End window open a little; windows in room open.
" 21,	2.45	63	2	13	End window open; cool draught.
Average, . . .			10	24	

Ward L (Female), Isolating Ward. Samples taken Mornings.

Dec. 11,	11.15	65	4	99	Pretty quiet; some walking about.
" 17,	10.[illegible]	-	5	12	Quiet.
" 26,	12.00	-	19	11	End window open; quiet.
Average, . . .			9.3	40.7	

Patients' Rooms. — As before stated, these rooms are 14 feet by 15 feet, with a cubic space in ward K of 2,940 cubic feet, and in ward L, 3,780 cubic feet. With two or three patients in a room, the cubic space is ample; but in ward K, with four patients in a room, which the demands upon the ward frequently necessitate, the cubic space is rather small.

The following tables show the results of one determination in each room, the rooms being numbered from 1 to 12 in each ward: —

Ward K (Male), Medical and Surgical. (February 4.)

Time.	Room.	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
10.30 A.M.	1	86	4	6	2	Strong draught.
2.05 P.M.	2	75	2	10	7	Porter's room; strong draught; 2 occupants; 1 asleep.
10.45 A.M.	3	82	1	15	6	Strong draught.
1.50 P.M.	4	28	4	11	9	Three medical; 1 surgical; swept 1¼ hours before; slight warm draught.
11.00 A.M.	5	74	3	37	3	Three medical; strong draught; 2 patients up; bad odor.
1.30 P.M.	6	73	4	22	6	Four surgical patients; swept 1½ hours before; transfer made and erysipelas patient brought in.

Ward K (Male), Medical and Surgical. (February 4.) — Concluded.

Time.	Room.	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
11.10 A.M.	7	61	-	9	6	Strong draught; no patients.
1.15 P.M.	8	75	4	18	1	Two medical; 2 surgical; strong draught; swept 1 hour before; 2 patients up.
12.45 "	9	70	4	11	4	Four surgical; slight draught; 1 patient up; swept after dinner.
1.00 "	10	72	4	-	-	Three surgical; 1 medical; draught strong; swept 3¼ hours before; 2 patients up.
1.25 "	11	79	6	15	5	Private room; cool draught through radiator.
2.40 "	12	65	-	11	4	Kitchen.
Average, ...				15	4.4	
Open air, ...				3	2	

Ward L (Female), Medical and Surgical. (February 4.)

Time.	Room.	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
10.20 A.M.	1	70	3	4	9	All medical; 2 patients up; quiet; slight draught.
10.40 "	3	72	4	-	-	
10.55 "	4	72	3	0	9	All medical; quiet; slight warm draught.
11.05 "	5	72	3	3	7	All medical; quiet; strong warm draught.
1.15 P.M.	6	72	4	3	7	Two medical; 2 surgical; swept 1 hour before; 1 patient up; strong draught.
1.45 "	7	69	3	10	10	All medical; swept 1½ hours previous; strong draught; quiet; floor not clean.
1.30 "	8	72	3	10	11	Bad smell; swept 1 hour previous; strong draught; floor not clean.
2.00 "	9	69	2	6	3	One medical; 1 surgical; swept 1½ hours previous; floor clean.
2.15 "	10	72	4	14	5	One medical; 3 surgical; floor swept 1 hour previous; strong draught.
2.30 "	11	68	2	-	-	Floor swept 2 hours previous; 1 medical; 1 surgical.
2.45 "	12	68	2	4	17	One medical; 1 surgical; quiet; floor swept 2 hours previous.
Average, ...				5	8.7	
Open air, 9.55 A.M. . .				19	3	

These tables show a most excellent condition of the air of these rooms as regards micro-organisms. The number of bacteria found in ward K, although three times as many as in ward L, compares favorably with other parts of the hospital. The writer is of the opinion that the differences between wards K and L are more apparent than real. and that more organisms are present in the rooms in ward L than the determinations of air indicate, although perhaps not so many as in ward K. No other wards of the hospital furnish similar rooms for comparison; but the rooms of certain employees (women) on the third floor of the administration building (see table, p. 190) are not unlike them, in that they contain from two to four beds. Here were found an average of 20 bacteria against 15 for the rooms in ward K, and 5 for rooms. in ward L. There was nothing in the condition of the rooms that would indicate whether the numbers of micro-organisms would be high or low. Most of the windows were closed, but the doors opening into the corridor were open. A strong draught of warm air came from the radiator, indicating an abundance of fresh air. In room 5, ward K, giving the highest number of bacteria, a disagreeable odor was noticed; but this was the only room where any offensive odor was detected. These rooms certainly show a freedom from micro-organisms scarcely to be expected from the class of cases assigned to them.

Contagious Wards, A and E.

The two new wards for infectious diseases are practically alike. They occupy the space shown in plate No. I., between the isolating wards and the medical ward numbered 4. They are connected with each other and the rest of the hospital group by two-story corridors, the upper story being open and the lower one enclosed.

Each building may be considered as divided into five sections. The centre section contains the service rooms; on either side is an open ward, and in the end sections are placed the isolating rooms. A second story over each end section furnishes room for more complete isolation of patients, when necessary. The open wards are 25 feet 8 inches, by 35 feet 4 inches, and are 16 feet high; giv-

ing to each bed, eight in number, 1,200 cubic feet of air.

In the centre of each ward is a square ventilating shaft, 5 feet by 4 feet, and on two sides are fireplaces. None of the basement rooms are intended for occupancy. The space under the wards has concrete floors, and is whitewashed. Air is admitted by direct inlets, placed at proper intervals in the basement walls, and by means of a diaphragm may be made to pass over coils in galvanized iron boxes, or may pass directly to the wards without going over the coils. The system will supply 48,000 cubic feet of warm air per hour, or 6,000 cubic feet per patient. The upper portions of the wards are ventilated through register faces in the walls and ceilings, and thence upwards to a ventilating ridge chamber. The lower portions of the ward are ventilated downwards through registers in the floors, and thence to the aspirating shaft in the centre of each ward. The capacity of each ward is 24 beds, or, including the chambers, a total capacity for both wards of 72 beds. Ward A is devoted to the treatment of scarlet-fever, ward E to diphtheria.

Contagious Wards.

Ward A (Scarlet-fever). Samples taken Afternoons, November, 1888.

Date.	Time.*	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
Nov. 10,	-	72	4	1	2	Sample taken in A, North. Ward quiet.
" 15,	-	73	7	12	2	Sample taken in A, South. Three visitors present. Ward quiet.
" 21,	-	64	7	0	2	Sample taken in A, North. Ward quiet.
Average,				4.2	2	

Ward E (Diphtheria). Samples taken Afternoons, November, 1888.

Date.	Time.*	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
Nov. 1,	3.00 P.M.	73	5	4	5	Sample taken in E, South.
" 10,	2.15 "	72	4	7	6	Sample taken in E, North. Ward quiet.
" 15,	2.45 "	73	7	17	0	Sample taken in E, South. Three visitors. Nurse caring for patients. Ward quiet.
" 21,	3.15 "	74	7	1	5	
Average,				7.1	4	

Ward E (Diphtheria). Samples taken Mornings, December, 1888.

Date.	Time.	Temperature, Degrees.	Number of Patients.	Bacteria.	Moulds.	Remarks.
Dec. 1,	12.00 A.M.	68	4	0	7	Sample taken in E, South. End window open.
" 5,	11.35 "	69	6	0	0	Sample taken in E, North. Ward quiet.
" 10,	11.35 "	74	7	4	7	Sample taken in E, South. One visitor.
" 14,	10.35 "	65	-	8	4	Sample taken in E, North. Making beds.
" 26,	11.40 "	-	6	5	17	
Average, ...				5.8	6.4	

The above tables, representing the determinations made in the contagious wards, show a freedom from micro-organisms not to be found in any other wards of the hospital, the nearest approach to them being the three female medical wards, Q, R and S (see table, p. 174).

These buildings, being divided into sections, although communicating, furnish wards about the size of Q, R and S, but with fewer beds; and the results obtained in wards of this character show that they are less likely to become contaminated with micro-organisms than the larger wards.

All the conditions which are unfavorable to a vitiated atmosphere, except the patients themselves, are found in these wards. The buildings are new, sanitary conditions perfect, ventilation good, cubic space large, great cleanliness of rooms and furniture, and an intelligent and abundant use of disinfectants. Nevertheless, in spite of the greatest precautions, the opportunity of infectious material being set free in the room exists in the treatment and care of patients. Diphtheritic patients especially receive a vast amount of spraying, douching and painting of throats. Discharges from the mouth and nose are very profuse, and offensive in odor. Cloths, bits of rag and feathers are used in removing such discharges; but, with all precautions, bedding and clothing of patients, especially children, must become more or less contaminated, and from these infectious material is transmitted to the air.

The duties of the nurses in these wards are very laborious;

but, the separate wards being small, the work is carried out in a quiet manner, and the commotion of the larger wards is never seen in them.

Up to the present point, it has been the object of this paper to show the number and distribution of micro-organisms in the wards of the hospital; it now remains to consider some other facts brought out by these experiments. It has been shown that the micro-organisms present in the air of a room in the forenoon exceed those found in the afternoon, and that this is due to the disturbances which always occur in the morning. We should therefore think of them as associated with the room itself, rather than with the air; for the air of a room, if left undisturbed, soon becomes practically free from organisms. That there are micro-organisms at all in the air of rooms, depends upon whether they are occupied or not, or upon the degree of commotion in them. With a view to finding out how nearly the air of the wards became free from micro-organisms under the most favorable conditions, the following experiments were carried out between eleven and twelve o'clock at night: —

Night Work.

Date.	Ward.	Time.	Bacteria.	Moulds.
Dec. 27, ...	B	11.20 P.M.	1	4
" 27, ...	C	11.45 "	2	1
" 27, ...	D	12.10 A.M.	0	2
" 28, ...	F	11.15 P.M.	1	0
" 28, ...	G	11.35 "	0	1
" 28, ...	H	11.52 "	13	3

Between seven and eight o'clock P.M. helpless patients are made comfortable for the night, others prepare for bed, and at eight o'clock the lights are turned out. One person is on duty in each ward during the night. Usually a few very sick patients require attention; but, with this exception, the wards remain quiet until morning.

It will be noticed, from the table of night work, that the wards in which these determinations were made are those belonging to the large three-story medical and surgical buildings, where all our greatest numbers of micro-organ-

isms were found. These experiments show conclusively that the air of a room vitiated by bacteria will in three or four hours become practically free from them, if disturbing influences are removed. The determination in ward H gave 13 bacteria and 3 moulds, — numbers nearly as large as we should obtain under ordinary conditions. Unusual results of this kind cannot be anticipated, and, as four or five days are required to complete a determination, the cause can seldom be traced. The moulds are a trifle higher than the bacteria, in numbers; which is what we should expect, for we know that moulds are relatively lighter than bacteria, and of course remain suspended longer.

Experiments Before and After Sweeping.

The following experiments were undertaken to bring out more clearly the effects of unusual disturbances in increasing the numbers of micro-organisms in the air of a ward. The greatest amount of commotion occurs between 7.30 and 9.30 A.M., and the greatest amount of dust is caused by the first sweeping of the morning. There is a good deal of dust, lint, etc., upon the floor of these large wards in the morning; and, as dust and micro-organisms go hand in hand, we should expect to find micro-organisms more abundant just after sweeping than at any other time. The following table of determinations, made just before and after sweeping, shows this to be the case : —

Date.	Ward.	Before Sweeping.		After Sweeping.	
		Bacteria.	Moulds.	Bacteria.	Moulds.
Dec. 18, ...	F	56	1	99	2
" 27, ...	B	23	3	55	26
" 27, ...	C	32	22	104	40
" 27, ...	D	31	32	30	37
" 28, ...	F	104	2	160	3
" 28, ...	G	45	2	38	15
" 28, ...	H	43	8	81	1
Jan. 2, ...	P	40	12	10	11
" 2, ...	T	26	15	24	13
" 3, ...	B	20	6	7	30
Average, ...		42	10.3	70.8	17.8

The average number of bacteria found after sweeping is seen to be nearly twice the number found before sweeping. The ratio of bacteria to moulds in these wards is in the proportion of 4 to 1, under both conditions.

The table not only shows the effect of sweeping, but the whole general effect attending the opening of a large general ward in increasing the number of micro-organisms. We have seen by the previous table of determinations, made about midnight, that the micro-organisms of a ward practically all settle out in three or four hours. It follows, then, that the air remains free from them throughout the night, and is free at the time of opening the ward. The number of bacteria present in ten litres of air at any time after midnight is one or less than one. If, then, we consider the number present at the beginning of the hospital day as one, the increase in numbers due to disturbances caused by routine work of the morning, other than sweeping, would be as 42 to 1; and, including sweeping, as 71 to 1.

Probably the greatest factor, next to sweeping, in increasing the number of micro-organisms in the air of a room, is bed-making. The hospital bed, made up, measures about 8 feet 3 inches, by 2 feet 6 inches; which gives, in a ward of 28 beds, 577 square feet of surface area, — a little more than one-fourth the total floor area. These beds, of course, cover an amount of floor space equal to their size; so that, in reality, the surface which they present to falling organisms is about one-third the whole surface exposed. In the process of bed-making, many of the organisms which have previously settled out upon the clothes are again wafted into the air, as of course would be any bacterial discharges with which the bed linen might be contaminated. I refer particularly to very slight discharges; for, in case of noticeable discharges, the soiled linen is immediately removed, with proper precautions.

Ventilating Ridges.

Each hospital building is surmounted by a ventilating ridge, into which the foul air of the ward passes, either by means of flues in the wall or through large openings along the centre of the ceiling. From thence it passes directly

to the outer air through large ventilators, placed at equal distances along the top of the ridge. These chambers extend along the roof over that portion covering each ward; they are about 5 feet wide, and of more than sufficient height to permit an upright position. The roof of each chamber is peaked, and made of glass. They can be heated by steam if necessary, but this is seldom, if ever, resorted to.

It was thought to be a question of considerable importance to determine the relation between the air of these chambers and that of the wards; for such knowledge leads directly to the important question, whether or not there is elimination of micro-organisms in a mechanically ventilated building.

Ridges designated H and D discharge the air from the large three-story medical and surgical buildings, containing wards F, G and H, and B, C and D respectively; while ridges P and T discharge for the one-story buildings, wards P and T.

Ventilating Ridges.

Date.	Ridge Chamber.	Bacteria.	Moulds.	Bacteria in Air of Wards.	Moulds in Air of Wards.	Remarks.
Dec. 7,	P	57	9	21	7	Strong upward draught.
" 12,	D	2	8	9	5	Ventilators drawing well; no currents felt in the chamber.
" 18,	D	2	1	10	2	Ventilators drawing well; no currents felt in the chamber.
" 19,	H	3	1	106	6	Ventilators drawing well.
" 24,	T	1,149	0	8	1	Good upward currents from ward below; not much from wall outlets.
" 24,	P	6	5	5	14	Good upward currents from ward below; not much from wall outlets.
" 27,	D	6	22	31	32	Ventilators drawing gently.
" 28,	H	17	7	81	1	Ventilators drawing well.
Jan. 2,	T	12	3	26	15	Strong draught from ward below; slight from wall outlets.
" 2,	P	4	10	40	12	Strong draught from ward below; slight from wall outlets.

The tables give, in addition to the micro-organisms found in the air of the ventilating chambers, the number of bacteria and moulds in the air of the wards just beneath, about fifteen minutes before. The table shows, for the most part, extremely small numbers of micro-organisms, — so small as to

lead at once to the conclusion that the air, in passing from the wards below, does not carry with it micro-organisms to any considerable extent.

It is safe to say that, in wards without special means of air outlets, and with only ordinary means of ventilation, micro-organisms do not escape; but in wards like P and T, with exceptionally good ventilation, they do escape, and the total number in the ward is thereby much diminished.

From the fact that micro-organisms settle out so rapidly, probably floor ventilation, such as exists in the contagious wards, aids materially in the elimination of micro-organisms; but the most efficient means for ordinary rooms, after sweeping or any unusual disturbance, is a good current of outdoor air, by means of open windows and doors.

Administration and Other Buildings.

So far as I am aware, no standard has been proposed for the number of micro-organisms habitually present in the air of hospital wards. The terms large and small, as applied to the number of organisms found in this investigation, have therefore been used entirely in a relative sense. The determinations that have been made upon outside air, while useful as a comparison, cannot properly be taken as a standard of the purity of the air of rooms; for individual experiments made on outside air and the air of wards at about the same time show no relation whatever, and it is quite possible for rooms of the better class to contain far less organisms than outside air. In the absence, then, of a proper standard of purity for hospital air, it seemed to the writer that an investigation of the air of certain hospital buildings not occupied by the sick would afford a useful means of comparison. With this object in view, the air of the following buildings was examined: —

First. — Administration building.

Second. — Nurses' home.

Third. — Laundry, with rooms of the laundry employees.

Administration Building.

The number of micro-organisms found in various places on each floor of the administration building is shown by the following table: —

ADMINISTRATION BUILDING.

First Floor.

PLACE OF EXPERIMENT.	Date.	Bacteria.	Moulds.
Reception-room, ...	Jan. 5,	64	2
Hall, ...	" 5,	48	6
Dining-room, ...	" 5,	18	7
Private office, ...	" 5,	12	2
Average, ...		35.5	4.3
Second Floor.			
Sleeping-room, ...	Jan. 5,	1	1
Library, ...	" 5,	1	2
Parlor, ...	" 5,	5	5
Hall, ...	" 5,	1	7
Sleeping-room, ...	" 5,	2	5
Average, ...		2	4
Third Floor. — Domestics' Rooms.			
Room 1, ...	Jan. 12,	3	5
" 3, ...	" 12,	28	0
" 4, ...	" 12,	37	4
" 5, ...	" 5,	34	20
" 6, ...	" 5,	14	8
" 7, ...	" 5,	5	9
Average, ...		20 3	9.7

First Floor. — This floor (plate I.) contains, besides a spacious hall, the superintendent's office, matron's room, family dining-room, and a large reception-room. This, being the executive department, is visited each day by many hundred people, representing all classes of society. Such is the neatness and the order of this floor, however, that no

indication is ever seen of the immense amount of business transacted. The largest number of bacteria was found in the reception-room and hall, where the greatest amount of activity exists. In the dining-room and office the numbers were much less. That bacteria are here present in the numbers found in the reception-room and hall, shows plainly how these organisms are transported by people coming from outside air into a room, by dirt on their feet and clothing.

Second Floor. — A plan of this floor is shown by plate II. Here are the living-rooms of the superintendent and a few of his officers. It corresponds to a private house of the first class. The table of data shows the air of this floor to be almost free from bacteria, as might be expected from the cleanliness and quiet which prevail.

Third Floor. — The third floor (plate III.) is divided into chambers for the use of domestics; the rooms are small, low studded, and the ventilation is poor, being only by transom windows. Consequently, a larger number of bacteria is found in the air of these rooms. The rooms are vacant most of the day, and were vacant at the time of the experiment.

Nurses' Home.

This building differs from any that has been considered; it is new, outside the hospital grounds, and is reached by a short walk in the open air. It is four stories in height, each floor having a central corridor extending its whole length, from which nurses' rooms open on either side. It is essentially what its name implies, — "a nurses' home," where quiet and comfort are found by the nurses after their duties at the hospital are over. The nurses leave the building at about 6.30 A.M., and return for the night at 8 P.M. The samples of air were all taken at about the centre of each corridor. The table below shows for the air of this building very small numbers of bacteria. Even in the morning, with housework going on, the average number of only nine bacteria were found; while in the evening, after so many nurses, fifty or sixty, had entered the building, and distributed themselves throughout its various parts, the air showed an average of but three bacteria. These results show that bacteria are not transported from the hospital wards to the

"home," at least in any appreciable numbers, and that they are not accumulated by any cause.

The very moderate number of bacteria found in this building is evidence enough that the air of even a large building may be kept comparatively free from bacteria, under proper hygienic conditions. It is noticeable that the number of bacteria found is less than we should expect to find by the same number of determinations on outside air.

NURSES' HOME.

Samples taken Jan. 4, 1889, 9 to 10 A.M.

CORRIDOR.	Bacteria.	Moulds.	REMARKS.
Basement,	7	20	Strong draught.
First floor,	18	59	Before sweeping; floor dirty.
Second floor,	3	7	Very quiet; floor clean.
Third floor,	10	11	Floor partly swept.
Fourth floor,	9	16	Sweeping finished before experiment.
Average,	9.4	22.6	

Samples taken Jan. 4, 1889, 8 to 9 P.M.

CORRIDOR.	Bacteria.	Moulds.	REMARKS.
Basement,	0	20	Very hot; no one present.
First floor,	2	4	Quiet.
Second floor,	3	8	Very little walking.
Third floor,	5	17	Very quiet; some draught.
Fourth floor,	7	16	Very quiet.
Average,	3.4	13	

Laundry.

In this building we have a wash-room and an ironing-room on the first floor, and the sleeping-rooms of the laundresses on the second floor. Every morning the soiled ward linen is taken to the wash-room, and assorted into special lots preparatory to washing. The handling of such a large amount of soiled ward linen should be a prolific source of air infection in this room; but, as will be seen from the table of determinations, the number of bacteria, although large, is not extraordinary. The day, however, on which the samples were taken, was very windy; and, the door being open, a very strong current of air was blowing through, which may have carried off a large number of

micro-organisms. Still, a larger number of bacteria was present in the wash-room than in the ironing-room, which connects directly by an open door. The rinse-house is a small out-building, in which the preliminary cleansing is given to especially foul clothing. Here, again, a pretty large number of bacteria was found, in the presence of very free air currents.

Up a narrow staircase one passes to a corridor out of which lead the laundresses' rooms. They are small, low studded, badly ventilated, but quite cleanly, owing to the strictness of the hospital rules. There is an extremely offensive odor in most of these rooms, which is attributed by the administration to the uncleanly habits of women of this class. In the morning the determinations were made after the rooms had been vacated several hours, but in the evening the women were sitting quietly in their rooms. The number of bacteria found shows undoubted evidence of vitiation of the air, due to personal uncleanliness; for the rooms themselves are clean, and it is noticeable that in the evening, with the women present, although not stirring about, the numbers increased. This is in direct contrast with the results found in the nurses' home, where, under similar conditions of experiment, the numbers found in the evening were less than in the morning.

According to the class of inhabitants, then, the number of bacteria was found to increase: for instance, in the dwelling apartments of the superintendent there was an average of 2 bacteria; in the nurses' home we have an average of 9.4 bacteria; in the domestics' sleeping apartments in the administration building were 20.3 bacteria; and worst of all the laundry employees' rooms, where there were 36.7 bacteria.

Laundry.

Place of Experiment.	Date.	Bacteria.	Moulds.
Ironing-room,	Jan. 7,	23	17
Rinse-house,	" 8,	43	5
Wash-room,	" 8,	33	7
Wash-room,	" 8,	84	6
	Average,	45.7	8.9

Rooms of Laundry Employees.

Morning.				Evening.			
Date.	Room.	Bacteria.	Moulds.	Date.	Room.	Bacteria.	Moulds.
Jan. 7,	1	38	2	Jan. 7,	1	57	1
" 7,	2	5,440*	0	" 7,	2	44	2
" 7,	3	14	2	" 7,	3	50	13
" 7,	4	27	4	" 7,	4	6	1
" 7,	5	31	2	" 7,	5	82	1
" 7,	6	40	3	" 7,	6	1	2
" 7,	7	28	1	" 7,	7	72	0
" 7,	8	18	9	" 7,	8	14	3
" 7,	9	24	10	" 7,	9	13	0
" 7,	10	33	6	" 7,	10	28	6
Average, .		28	4.7	Average, .		36.7	3

* Omitted from average.

Basements.

As a matter of general information, determinations of the air in the basements were made. The results are embodied in the following table:—

Date.	Basement under Ward.	Bacteria.	Moulds.	Remarks.
1888.				
Dec. 7,	P	0	101	One window on each side open; closed during experiment.
" 14,	Q	7	10	
" 17,	K	0	7	Cool and damp; strong smell.
" 18,	B	4	13	
" 19,	F	0	8	
" 24,	T	3	10	End window open; slight draught.
" 24,	P	1	36	One window open.
" 27,	B	0	69	
" 28,	F	2	3	
" 31,	Q	4	6	
1889.				
Jan. 2,	T	0	6	
Average, . .		2	16.3	

These basements are used to some extent for the storage of furniture and other hospital property; aside from this, they serve only as open air spaces, the windows being open

in favorable weather. The walls are of solid masonry, and the floors are of concrete. Doors for the most part are kept locked, and with occasional whitewashing the basements are always clean and wholesome. It is evident from the table that bacteria do not find a congenial climate in these basements, for they are notably absent. On the other hand, moulds abound in considerable numbers; but lack of dampness and darkness keeps the numbers far below what we should find in an ordinary cellar. The presence of moulds in an atmosphere disturbed only by the leakage of air through windows, or at the most through open windows, in favorable weather, makes evident their relative lightness.

The Bacterial Examination of Air after the Fumigation of Infectious Clothing by Sulphur.

It is not within the scope of this paper to investigate the efficiency of sulphur as a fumigating agent, and no attempt has been made to do so. The experiments presented were suggested by the fact that bed-making in the wards furnished a means of air-infection. The bringing together of large quantities of bed linen for fumigation, from the infectious wards, it was thought, would vitiate the air unmistakably, and become manifest, with a few determinations of air, in the small confined space of the fumigating vault. The experiments were, however, extended, so that in reality they became a measure, not of the efficacy of sulphur as a fumigating agent, but of the method of fumigating employed in this hospital. The fumigation of infectious clothing undertakes to kill not alone the bacteria that may be present, but also the more refractory spores; and any method which fails to kill every germ and every spore, is worthless.

A description of the fumigating vault and the method of fumigation employed is as follows. The vaults are of brick masonry in the corner of a basement room, one under the contagious ward A, the other under contagious ward E. They are 16 feet long, by 9 feet wide and 9 feet high. Racks are built upon two sides, on which to deposit clothing. Tightly fitting double doors prevent the escape of sulphur fumes during fumigation, and a flue connecting with a chimney removes the fumes after fumigation is completed. All soiled

clothing from the contagious wards is sent down shutes into the basement, and on certain days of the week is removed to the vault and immediately fumigated. This is accomplished by burning in an iron pot about ten pounds of sulphur, the heat from the pot placed in a pan of water furnishing a certain amount of moisture. The exposure given is usually from six to eight hours.

In the experiments to be described, the following procedure was carried out: —

First. — A determination of the air of the room outside the fumigating vault.

Second. — A determination of the air within the fumigating vault, empty.

Third. — A determination of the air within the vault, with clothing distributed, and ready for fumigation.

Fourth. — A determination of the air within the vault, after fumigation, and in the presence of sulphur fumes.

Fifth. — A determination of the air within the vault, after the escape of the sulphur fumes.

Sixth. — A determination of the air within the vault, after the clothing had been fumigated and violently shaken.

Seventh. — A determination of the air within the vault, after the clothes had been removed.

Eighth. — A determination of the air within the vault, after a period of repose.

Ninth. — Between determinations one and eight, frequent determinations were made of the air outside the vault, as a control.

Two series of experiments were carried out, one in vault A, the other in vault E, that one might serve as a control upon the other. Of course no agreement is to be expected between the actual number of micro-organisms found in corresponding experiments of the two series, because the conditions which influence the numbers necessarily differ at different times; for example, the gross amount of clothes operated upon varies at each fumigation, the clothes themselves present different degrees of infection, and the amount of disturbance to which they are subjected will differ. Only a general agreement, therefore, must be looked for at certain critical points.

The following tables represent the results of the two series of experiments: —

Table A. Experiment 1.

Number of Determination.	Date.	Bacteria.	Moulds.	Time of Day.	Place of Experiment. — Remarks.
	1888.				
1,	Dec. 9,	0	34	9.45 A.M.	Room outside of vault.
2,	" 9,	4	19	10.09 "	Inside of vault; doors open.
3,	" 9,	0	29	10.50 "	Inside of vault; clothes on racks ready for fumigation.
4,	" 9,	3	98	11.04 "	Outside of vault.
5,	" 9,	2	13	5.50 P.M.	Outside of vault.
6,	" 9,	0	0	6.05 "	Inside of vault, in presence of sulphur fumes
7,	" 10,	3	3	8.45 A.M.	Inside of vault, after discharge of sulphur fumes; doors closed during the night.
8,	" 10,	49	28	9.00 "	Inside of vault; doors closed; clothes well shaken.
9,	" 10,	1	31	9.15 "	Outside of vault.
10,	" 10,	25	28	10.00 "	Inside of vault; clothes all out.
11,	" 10,	5	50	2.20 P.M.	Inside of vault; after repose.

Table E. Experiment 2.

Number of Determination.	Date.	Bacteria.	Moulds.	Time of Day.	Place of Experiment. — Remarks.
	1888.				
1,	Dec. 15,	36	21	9.00 A.M.	Outside of vault.
2,	" 15,	19	12	9.15 "	Inside of vault; empty.
3,	" 15,	50	11	–	Inside of vault; clothes on racks ready for fumigation.
				–	
4,	" 15,	23	13		Outside of vault.
5,	" 15,	9	4	3.45 P.M.	Outside of vault.
6,	" 15,	0	2	–	Inside of vault, in presence of sulphur fumes.
7,	" 16,	2	5	8.30 A.M.	Outside of vault
8,	" 16,	3	11	8.45 "	Inside of vault, free from sulphur fumes.
9,	" 16,	10	4	9.20 "	Inside of vault, after clothes had been shaken; doors closed.
10,	" 16,	7	16	10.10 "	Inside of vault, after removal of clothes.
11,	" 16,	3	19	11.15 "	Inside of vault, after repose.
12,	" 16,	0	7	2.00 P.M.	
13,	" 16,	0	2	4.10 "	

Description of the Tables.

The determinations to be particularly noticed are Nos. 3 and 8, in table A, and Nos. 3 and 9, in table E. Determination 3 represents the air of the vault after an enormous quantity of infectious clothes had been shaken and thrown upon the racks. Determinations 8 and 9 show the same thing, after the clothes had been fumigated for several hours. Determination 3, in table A, for some reason difficult to see, gave negative results; but determination 8 of the same table shows that the organisms were there, and retained their vitality throughout the exposure to sulphur fumes. In determination 3, table E, the numbers of bacteria were distinctly increased by handling the clothes, and the same treatment after fumigation (determination 9) still furnished some germs, although in diminished numbers. In both cases, with the vault undisturbed but filled with sulphur fumes, the result was negative, as was to be expected. The subsidence of the germs is shown in both tables, more especially in table E, where the experiments were extended with that object in view. The control experiments on the air outside the vaults show that the results obtained within the vaults were not due to causes existing without.

It was evident to the writer, that, by throwing such a large quantity of bed linen upon the racks of the vault, much of it escaped the action of the sulphur fumes; for, with doors and ventilators closed, the atmosphere is "dead," and it would be impossible for sulphur fumes to penetrate and expel the confined air between the folds of such heaps of materials. In addition to bed linen, a certain amount of infected patients' clothing, done up in "emigrant bundles," and tied up in sheets, is fumigated at each operation. A large portion of these bundles is perhaps not infected with the germs of contagion, but is filled with vermin. A careful examination of many of them outside the vault after fumigation, showed not the slightest smell of sulphur fumes beneath the outer layers. This fact suggested the following experiments. Vault E, with closed doors, was swept vigorously, racks dusted, and then subjected to fumigation in the regular

way; after which the dust was again disturbed, and a determination of the air made.

No. 1. — Before fumigation, floor swept, racks dusted, vault filled with dust. Found: bacteria, 33; moulds, 77.

No. 2. — After fumigation, sulphur fumes all out, vault quiet. Found: bacteria, 0; moulds, 1.

No. 3. — Floors swept, racks dusted, vault filled with dust. Found: bacteria, 1; moulds, 1.

The above experiments demonstrate one of the practical applications to which the bacterial determinations of air may be put. A determination of the actual efficiency of a fumigating agent must be shown by the more refined methods of bacteriological investigation; i. e., the inoculation of material with known species or their spores, subjecting the infected material to the action of the fumigating agent, and subsequent culture for negative or positive results. Conclusions are evident: whether sulphur is or is not an efficient fumigating agent, the method, as carried out here, is worthless.

In the foregoing discussion of the number of micro-organisms in the various wards of the hospital, we are left in doubt whether the averages presented represent the conditions of the air from day to day, during the two months occupied in collecting the data, or whether individual determinations are true only for the days on which they were made. Nor can we tell whether a single determination made at a given time of the morning and afternoon, as in the experiments, represents a fair average for the day itself.

Circumstances connected with a hospital ward, which may increase or decrease the number of micro-organisms in the ward itself, do not, we think, materially change from day to day. A certain standard of cleanliness is maintained, routine nursing is thoroughly systematized, the number of patients and classes of diseases vary but slightly; so that each ward becomes endowed with a character of its own, to which a pretty constant number of micro-organisms undoubtedly belong. The numbers fluctuate considerably at different periods of a single day, according to the local disturbances in the ward; which throws some doubt on single

determinations, if given to express the condition of the air other than at the time of experiment. I have endeavored to trace these variations by a series of hourly experiments, conducted throughout the hospital day.

Hourly Experiments.

These hourly experiments were made in the six wards of the two three-story buildings, in the two one-story buildings, and in one contagious ward. Hourly determinations of carbonic acid were also conducted at the same time, to see what relation, if any, exists between carbonic acid and micro-organisms in the air of these wards. The experiments were all made in the centre of the ward, at about the breathing line. In all previous work the determinations were made with the wards in the exact condition in which they were found; but in the hourly experiments it was deemed advisable to keep windows and doors closed throughout the day, thus making the wards depend entirely on the mechanical ventilation. The tables are of especial value on this account, because they represent the wards in their most unfavorable condition. All the wards are thoroughly aired in the morning by open doors and windows, and, according to the weather, are open more or less during the day. This keeps the air free from disagreeable odors, and the temperature is to some extent regulated in this way. The following sketch of daily routine work of the hospital ward is given, as upon this depends largely the variation in numbers of organisms found at different periods of the day. To this must be added a considerable amount of movement by patients.

Routine of Daily Ward Work.

7–7.30 A.M.: —
  Breakfast served.

7.30–9 A.M.: —
  Beds made.
  Wards swept.
  Pulses and temperatures taken.
  Sputa cups emptied and cleaned.
  Typhoid fever patients bathed and cared for.

9–9.30 A.M.: —
  Bathing and caring for very sick patients continued.
  Poultices made and applied.

9–9.30 A.M.: — *Concluded.*
Lotions, liniments, etc., applied.
Nutrient and cathartic enemata given.
Convalescent patients dressed.
Physicians' visit.

9.30–12 M.: —
Milk, eggnog, etc., given.
Wards dusted, floors mopped.
Physicians' visit.
Hourly medicines given.

12–2 P.M.: —
Dinner served.
Medicines given, floors swept.
Tables dusted; general care of patients.
Poultices and dressings reapplied.

2–3 P.M.: —
Milk, eggnog, etc., given.
Wednesday and Friday, general bath days.
Monday, Tuesday, Thursday and Saturday, visiting days.
Medicines given.

3–4 P.M.: —
Temperatures taken.
General care of patients.

4–8 P.M.: —
Supper served.
Poultices reapplied.
Back of patients rubbed with alcohol or starch.
Milk or other drinks given.
House physicians' visit.
Medicines given.
Changes of beds requiring it, and other preparations for the night.

One of the most interesting facts brought out by these hourly experiments is the period of high numbers due to the excessive commotion of the morning, previously alluded to. This period unmistakably begins at the time of opening the ward, about 7 A.M., and continues until the ward is in order, which varies from 9.30 to 10.30 A.M. The number of bacteria in the air varies greatly for this period, in the different wards, for of course both duration and amount of commotion are variable conditions. The object sought for by the nurses is that the chamber-work, so to speak, shall be done as soon as possible, in order that the sick may be attended to, and the ward made presentable for the morning visit of the physician or surgeon. It seems unfortunate, that, in doing this, patients should be subjected to bacteria-laden dust, which is

for a time settling on their beds and person. This stirring up of the dust could probably be diminished by sprinkling the floor with some suitable material, wet with a proper disinfectant. It is now customary, in some of the wards, to use sawdust moistened with water; but it is used so sparingly as to be of little value.

This is a question of removing mechanically the micro-organisms, not of the air, but of the room itself; and the time is never so favorable as when they are in repose on the floor and furniture. Every accumulation of a sweeping means the elimination of a certain number of organisms; and if by any means the dust which is now scattered through the air at the period mentioned could be added to that already collected by the broom, the micro-organisms present would soon be reduced to a minimum. The tables of hourly work to follow show that, at the second and third sweeping, which occurs at 12.30 P.M. and 4.30 P.M., very little dust is raised, for the number of micro-organisms in the air are only slightly increased, if at all, at those times. Of the considerable number of organisms present in the air, in the morning, many fall on the beds, some on the floor, and some remain suspended. Those which settle upon the floor are in part removed by the mopping, which always follows the first sweeping, so that very few remain to be disturbed by any cause. The point at which commotion ceases and bacteria begin to settle out is clearly shown by the tables. In the medical wards F, G, H, the drop in numbers occurs at 10.30 A.M., and is quite marked. The time varies in the surgical wards, being 9.30 A.M. in B, 10.30 A.M. in C, and 11.30 A.M. in D; while in the medical and surgical pavilions, wards T and P, it occurs still earlier, — 8.30 A.M. in both wards.

There are several periods after 9 or 10 o'clock when slightly increased numbers of bacteria might be expected: namely, at 11.30 A.M., when dinner is served, followed by a second sweeping; at 4.30 P.M., the supper hour; and again at 7.30 P.M., when the beds are arranged and patients made comfortable for the night. These occasions give rise to disturbances slightly greater than those which immediately preceded them. In wards F, H, D and T, the number of bacteria were slightly increased at the time of second sweep-

ing; but wards B, C, G and P were not so affected. The third sweeping does not appear to increase the organisms; but all the wards except F and G showed a slight increase of bacteria at 7.30 P.M., falling again when the ward was closed at 8 P.M. It appears from the hourly experiments that in general the air from about 10 o'clock assumes practically a normal condition. The figures seldom quite agree, but a certain amount of variation must always be expected in bacterial examinations of air.

The number of micro-organisms found by hourly experiments, taken as a standard, furnishes the means of demonstrating the truth of the determinations made morning and afternoon, but on different days, during November and December. In the table below, the two series are given for all wards in which hourly experiments were conducted: —

Average of Hourly Experiments, from 6.30 A.M. to 8.30 P.M., January, 1889.

	F.	G.	H.	B.	C.	D.	P.	T.	E.
Bacteria, . .	64	21	43	13	19	19	12	13	7
Moulds, . .	36	2	12	19	7	10	5	7	6

Average of One Determination, Morning and Afternoon, November and December, 1888.

Bacteria, . .	41	47	48	16	27	15	14	17	7
Moulds, . .	5	6	9	10	12	17	11	9	5

With the exception of the bacteria and the moulds in ward F, and the bacteria in ward G, the above figures, considering the manner in which the data were obtained, correspond in a manner scarcely to be expected, and strengthen the opinion previously given, that the bacteria present in the various wards are practically constant from day to day. By referring to the figures below, taken from the tables which furnish the above averages, it becomes at once evident why the two series for wards F and G do not agree.

Ward F.

Determinations Made during December.		Hourly Determinations.	
Time.	Bacteria.	Time.	Bacteria.
–	–	6.30 A.M., . . .	477
7.55 A.M., . . .	104	7.30 " . . .	106
8.55 " . . .	77	8.30 " . . .	162
10.00 " . . .	56	9.30 " . . .	51
10.30 " . . .	24	10.30 " . . .	28

Ward G.

8.20 A.M., . . .	45	8.30 A.M., . . .	59
9.10 " . . .	56	9.30 " . . .	56
10.50 " . . .	48	10.30 " . . .	15
10.35 " . . .	176		

In ward F, the determination at 6.30 A.M. gave 477 bacteria, a number considerably greater than all others throughout the day combined; and in ward G, on December 8, at 10.35 A.M., the number of bacteria was 176. Both these numbers are exceptional and accidental; they are due to what Tyndall has so aptly called "bacterial clouds." Later, such "clouds" or aggregates of bacteria are probably uniformly distributed throughout the air. By eliminating these two numbers, the average number of bacteria for ward F becomes 34, in place of 64; and for ward G, 25, in place of 47. By this change, the table of comparative results for the two series agree in every case. Although 477 bacteria for ward F, at 6.30 A.M., must be regarded as accidental, moderately high numbers are always present at this hour in the male wards, where patients are stirring about; while in the female wards bacteria are not stirred up and distributed through the air until the regular opening up of the ward.

The column on the left gives the number of bacteria found on different days at different hours; that on the right, num-

bers found in the same wards at nearly corresponding hours to the former, but on the same day. The agreement is remarkable, and shows that on any day, at a given time, the number of bacteria in the air will be about the same in these wards.

The fact that the bacteria take such a sudden drop at about 10.30 o'clock A.M., and then remain practically constant for the rest of the day, permits a sharp dividing line between bacterial determinations of the morning and afternoon; and shows that, in bacterial determinations of the air of rooms, particular attention must be given to their condition, the amount, duration and character of any disturbing influences, and the time and number of the determinations made accordingly.

The two tables below represent the hourly determinations treated in two ways: First, by making the division at 10.30 A.M.; second, by making the division at 12.30 P.M., and taking the mean of the two parts in each case. They require no special comment.

Average of Hourly Determinations, from 6.30 A.M. to 8.30 P.M.

	Wards.								
	F.	G.	H.	B.	C.	D.	P.	T.	E.
Bacteria,	64	21	43	13	19	19	12	13	7
Moulds,	36	2	12	19	7	10	5	7	6
Carbonic acid,	7.10	6.30	8.02	–	5.53	7.05	5.68	5.72	5.62

Average of Hourly Determinations, from 6.30 A.M. to 12.30 P.M.

Bacteria,	121	27	56	17	16	28	20	15	8
Moulds,	47	1	16	19	4	11	4	3	4

Average of Hourly Determinations, from 1.30 to 8.30 P.M.

Bacteria,	19	15	29	9	21	10	5	3	9
Moulds,	21	3	7	20	9	10	5	11	9

Average of Hourly Determinations, from 6.30 to 10.30 A.M.

	Wards.								
	F.	G.	H.	B.	C.	D.	P.	T.	E.
Bacteria, . .	165	34	63	21	15	24	25	15	7
Moulds, . .	51	1	21	20	5	11	3	3	4

Average of Hourly Determinations, from 11.30 A.M. to 8.30 P.M.

Bacteria, . .	11	14	31	9	20	16	6	12	9
Moulds, . .	28	3	6	19	7	10	5	9	8

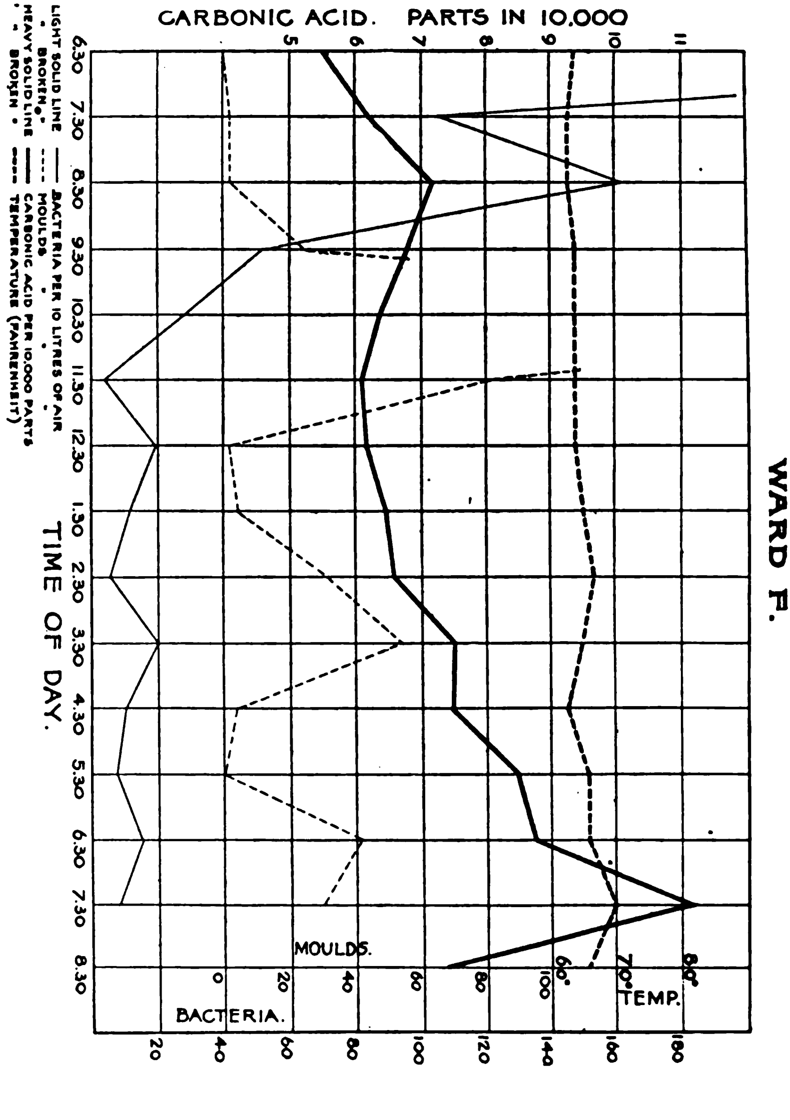
The statement previously made, that bacteria are more abundant in medical than surgical wards, is also shown to be true by hourly experiments. In the table below, the averages of hourly determinations are placed in a manner to show this, the results for each surgical ward being placed beneath the medical ward corresponding to it in situation.

Ward.	Bacteria.	Moulds.
F — Medical, ...	71	36
B — Surgical, ...	13	19
G — Medical, ...	21	2
C — Surgical, ...	19	7
H — Medical, ...	43	12
D — Surgical, ...	19	10
T — Medical, ...	13	7
P — Surgical, ...	12	5

The following tables give the full data of the hourly observations made in the various wards throughout the hospital day, from 7.30 A.M. to 8.30 P.M.

The charts were drawn from the data furnished by these tables and show graphically the fluctuation of carbonic acid, bacteria, moulds and temperature in Fahrenheit degrees from hour to hour.

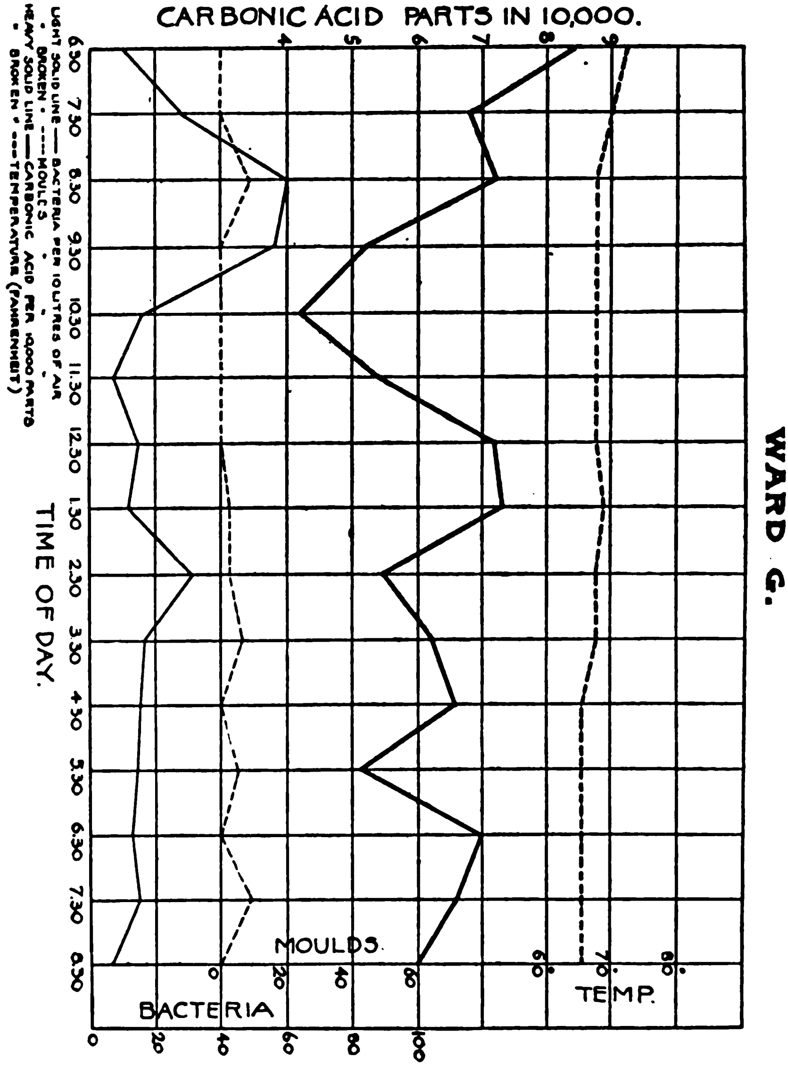
One fact shown by the charts is worthy of mention here: the proper time to mop a hospital ward is about one hour after the general sweeping; for the maximum number of bacteria appears to be reached just after sweeping and the minimum at about one hour later.


WARD F.
CARBONIC ACID. PARTS IN 10,000
TIME OF DAY.
MOULDS.
BACTERIA.
TEMP.
LIGHT SOLID LINE — BACTERIA PER 10 LITRES OF AIR
" BROKEN " --- MOULDS " " "
HEAVY SOLID LINE — CARBONIC ACID PER 10,000 PARTS
" " BROKEN " TEMPERATURE (FAHRENHEIT)

TABLES OF HOURLY DETERMINATIONS.

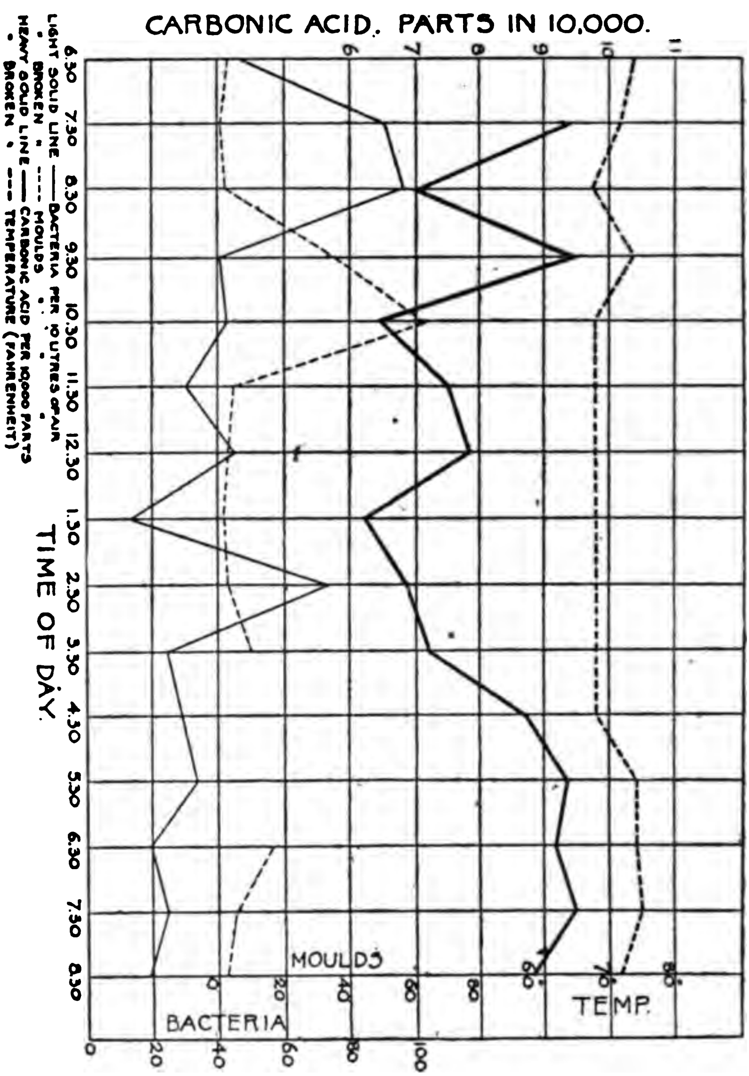
Ward F (Medical Ward, Male). Jan. 15, 1889.

TIME.	Temperature, Degrees.	Carbonic Acid.	Bacteria.	Moulds.	REMARKS.
A.M.					
6.30	64	5.51	477	0	
7.30	63	6.17	106	2	Sweeping almost finished.
8.30	63	7.22	162	2	Bed-making from 7.30 to 8.30; much walking about.
9.30	64	6.81	51	25	Second sweeping nearly finished.
10.30	64	6.40	28	227	Ward in order, and quiet.
11.30	64	6.13	3	81	Ward quiet.
P.M.					
12.30	64	6.18	19	2	Ward quiet.
1.30	65	6.50	11	4	Ward quiet.
2.30	67	6.63	5	31	Thirteen visitors present.
3.30	65	7.50	20	54	Taking temperatures.
4.30	63	7.48	10	4	Quiet.
5.30	66	8.46	7	1	Quiet.
6.30	66	8.40	15	42	Quiet.
7.30	70	11.20	8	30	Quiet.
8.30	66	7.36	-	-	Quiet.
Average, .		7.10	63.7	36	
Outside air,		4.99	-	-	


CARBONIC ACID PARTS IN 10,000.
4 5 6 7 8 9
WARD G.
6.30 7.30 8.30 9.30 10.30 11.30 12.30 1.30 2.30 3.30 4.30 5.30 6.30 7.30 8.30
TIME OF DAY.
LIGHT SOLID LINE —— BACTERIA PER 10 LITRES OF AIR
" BROKEN " ---- MOULDS " "
HEAVY SOLID LINE —— CARBONIC ACID PER 10,000 PARTS
" BROKEN " ---- TEMPERATURE (FAHRENHEIT)
MOULDS
0 20 40 60
60° 70° 80°
TEMP.
BACTERIA
0 20 40 60 80 100

Ward G (Medical Ward, Female). Jan. 24, 1889.

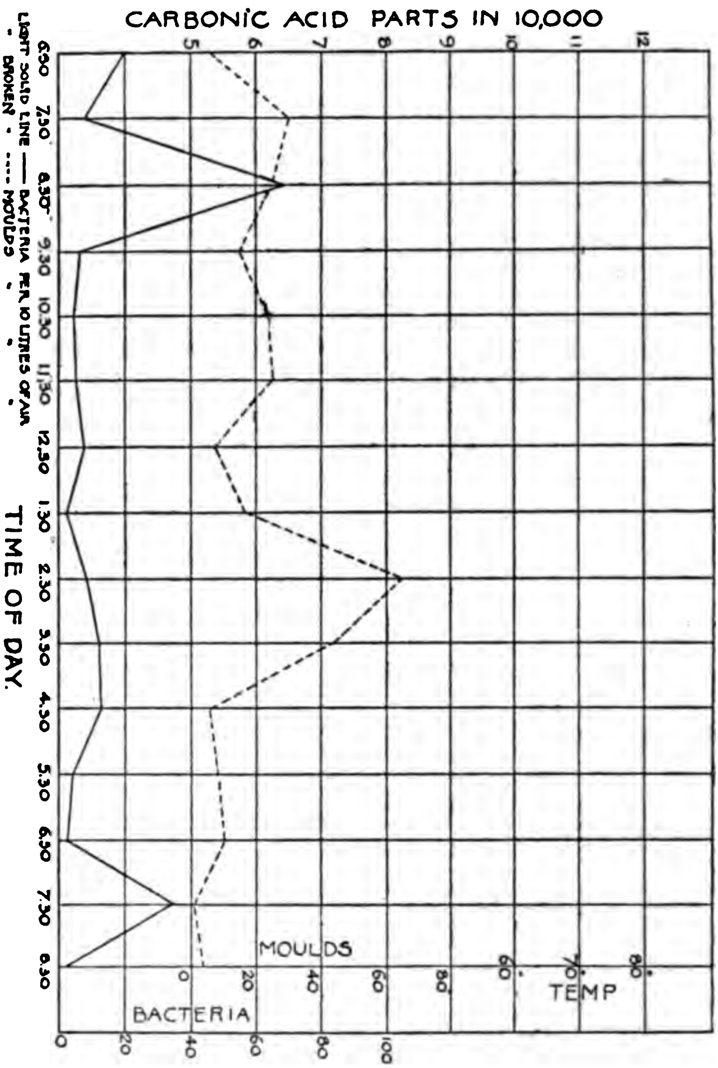
Time.	Temperature, Degrees.	Carbonic Acid.	Bacteria.	Moulds.	Remarks.
A.M.					
6.30	72	8.44	10	0	
7.30	70	6.83	28	0	
8.30	68	7.22	59	4	
9.30	68	5.21	56	1	
10.30	68	4.20	15	0	
11.30	68	5.43	7	1	
P.M.					
12.30	68	7.18	14	0	
1.30	69	7.33	11	2	
2.30	68	5.46	30	2	
3.30	68	6.15	16	6	
4.30	66	6.55	15	0	
5.30	66	5.09	14	5	
6.30	66	6.94	12	1	
7.30	66	6.63	14	8	
8.30	66	5.92	6	0	
Average, .		6.30	20.5	2	
Outside air,		4.74	-	-	


CARBONIC ACID. PARTS IN 10,000.
6 7 8 9 10 11
6.30 7.30 8.30 9.30 10.30 11.30 12.30 1.30 2.30 3.30 4.30 5.30 6.30 7.30 8.30
TIME OF DAY.
LIGHT SOLID LINE —— BACTERIA PER 10 LITRES OF AIR
" BROKEN " ---- MOULDS " " " "
HEAVY SOLID LINE —— CARBONIC ACID PER 10,000 PARTS
" BROKEN " --- TEMPERATURE (FAHRENHEIT)
MOULDS
0 20 40 60 80
BACTERIA
0 20 40 60 80 100
TEMP.
60° 70° 80°

WARD H.

Ward H (Medical Ward, Male). Jan. 25, 1889.

Time.	Temperature, Degrees.	Carbonic Acid.	Bacteria.	Moulds.	Remarks.
A.M.					
6.30	74	6.58	47	3	Several beds made; patients walking about.
7.30	72	9.39	90	1	Breakfast served; making beds.
8.30	68	6.91	96	2	Floor swept.
9.30	74	9.48	40	35	Physicians' visit, with twenty-nine students.
10.30	68	6.49	43	63	Mopping floor.
11.30	68	7.62	30	5	Quiet.
P.M.					
12.30	68	7.85	45	3	Sweeping floor.
1.30	68	6.24	13	2	Quiet.
2.30	68	6.85	73	3	Considerable walking about.
3.30	68	7.23	24	10	Quiet.
4.30	68	8.71	-	-	Quiet.
5.30	74	9.37	33	-	Gas burning.
6.30	74	9.24	19	16	Some walking about.
7.30	75	9.47	24	5	Some walking about.
8.30	72	8.89	19	3	Lights out.
Average, .		8.02	43.3	11.6	
Outside air,		-	-	-	

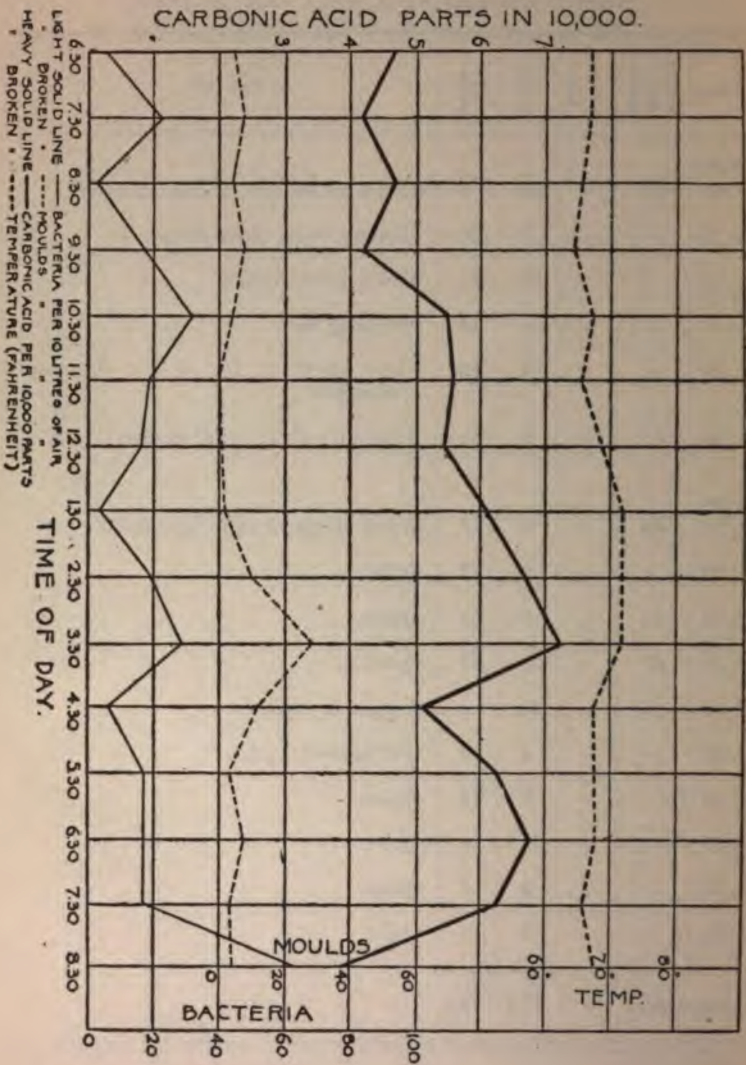

CARBONIC ACID PARTS IN 10,000
TIME OF DAY.
MOULDS
BACTERIA
TEMP
LIGHT SOLID LINE — BACTERIA PER 10 LITRES OF AIR
" BROKEN " .... MOULDS " " "

WARD B.

Ward B (Surgical Ward, Male). Jan. 3, 1889.

Time.	Temperature, Degrees.	Carbonic Acid.	Bacteria.	Moulds.	Remarks.
A.M.					
7.45	63	-	20	6	End window open; making beds.
8.25	-	-	7	30	Making beds; floor swept.
9.12	-	-	68	25	End window closed.
9.30	-	-	6	15	Mopping floor.
10.30	-	-	4	23	Floor swept at 10; a few dressings changed.
11.30	65	-	5	25	Surgeon's visit; ward in order, quiet.
P.M.					
12.30	68	-	8	7	Ward swept before experiment.
1.30	-	-	2	17	Quiet.
2.30	67	-	8	65	Quiet.
3.30	67	-	12	44	Quiet.
4.30	67	-	13	6	Supper brought in.
5.30	-	-	4	8	Gas lighted; quiet.
6.30	70	-	2	10	Quiet.
7.30	73	-	34	1	Quiet.
8.30	-	-	2	4	Quiet.
9.30	-	-	2	3	Quiet.
Average, .		-	13.1	19.3	

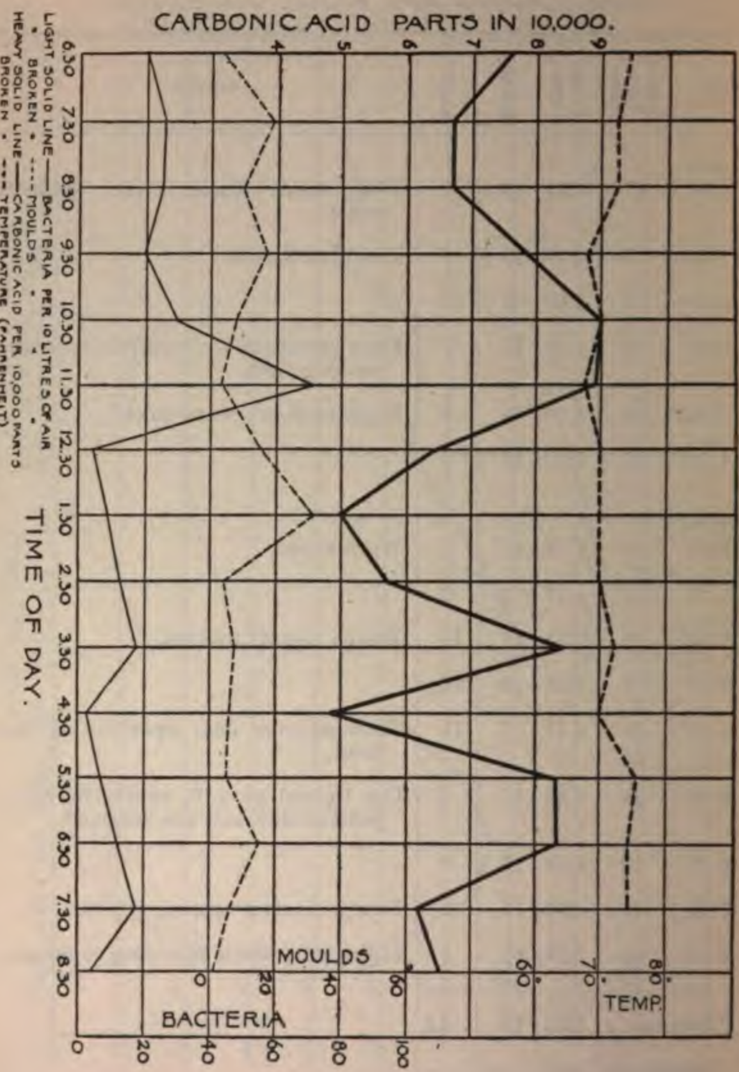
WARD C.


CARBONIC ACID PARTS IN 10,000.
3
4
5
6
7
TIME OF DAY.
6.30 7.30 8.30 9.30 10.30 11.30 12.30 1.30 2.30 3.30 4.30 5.30 6.30 7.30 8.30
MOULDS
0 20 40 60
BACTERIA
0 20 40 60 80 100
TEMP.
60° 70° 80°
LIGHT SOLID LINE —— BACTERIA PER 10 LITRES OF AIR.
" BROKEN " ---- MOULDS " "
HEAVY SOLID LINE —— CARBONIC ACID PER 10,000 PARTS
" BROKEN " ---- TEMPERATURE (FAHRENHEIT)

Ward C (Surgical Ward, Female). Jan. 22, 1889.

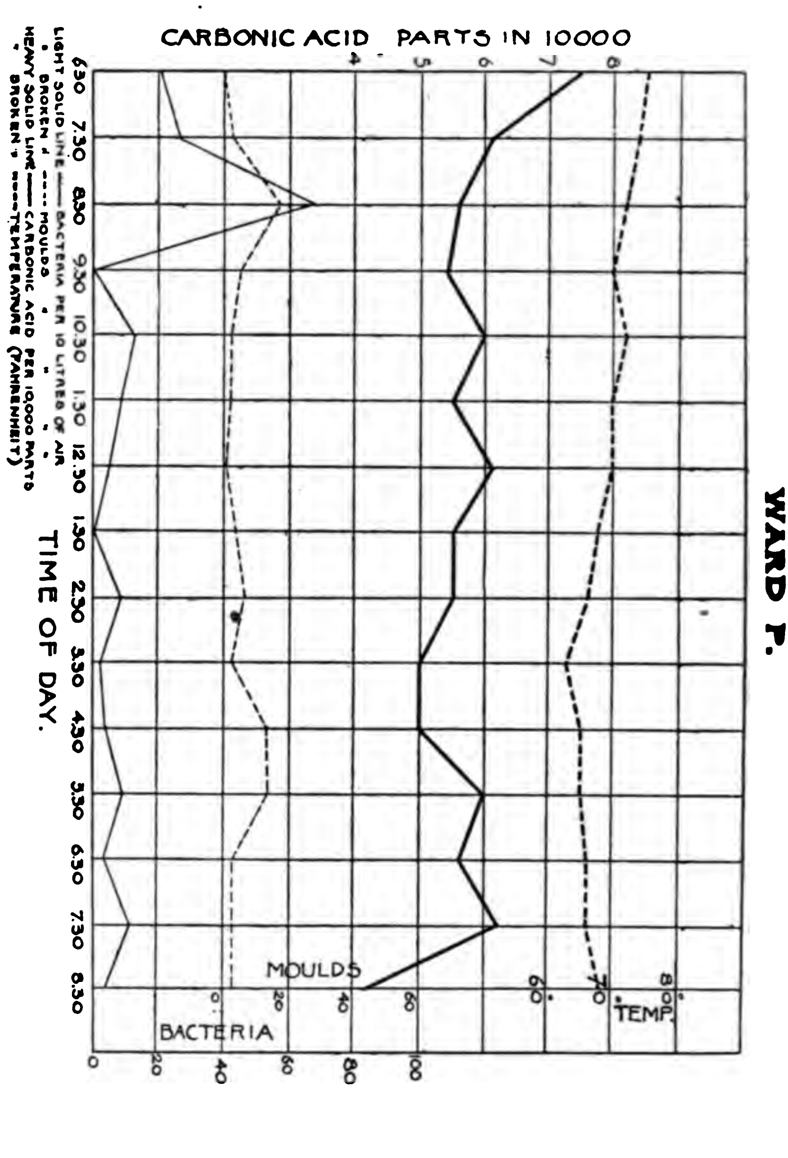
TIME.	Temperature, Degrees.	Carbonic Acid.	Bacteria.	Moulds.	REMARKS.
A.M.					
6.30	67	4.74	5	5	Disagreeable smell; close; patients quiet.
7.30	67	4.17	22	7	Breakfast served.
8.30	66	4.69	2	4	
9.30	65	4.19	17	7	Floor swept at 8.45; surgical dressings; making beds.
10.30	68	5.50	31	4	Mopping floor; ward quiet.
11.30	66	5.59	18	0	
P.M.					
12.30	69	5.48	16	1	Ward swept.
1.30	72	6.13	3	2	
2.30	72	6.74	19	10	Eleven visitors present.
3.30	72	7.29	28	28	
4.30	68	5.11	6	11	Transom over door open during last hour.
5.30	68	6.33	17	3	Gas lighted at 5 10, twelve burners; patient died, and was removed.
6.30	68	6.78	16	8	
7.30	66	6.33	17	3	Four patients preparing for bed.
8.30	68	3.91	63	4	Lights out; nurse attending to duties.
Average, .		5.53	19	6.5	
Outside air,		4.18	-	-	

WARD D.


CARBONIC ACID PARTS IN 10,000.
TIME OF DAY.
6.30 7.30 8.30 9.30 10.30 11.30 12.30 1.30 2.30 3.30 4.30 5.30 6.30 7.30 8.30
MOULDS
BACTERIA
TEMP.
LIGHT SOLID LINE —— BACTERIA PER 10 LITRES OF AIR
" BROKEN " ---- MOULDS " " "
HEAVY SOLID LINE —— CARBONIC ACID PER 10,000 PARTS
" BROKEN " ---- TEMPERATURE (FAHRENHEIT)

Ward D (Surgical Ward, Male). Jan. 23, 1889.

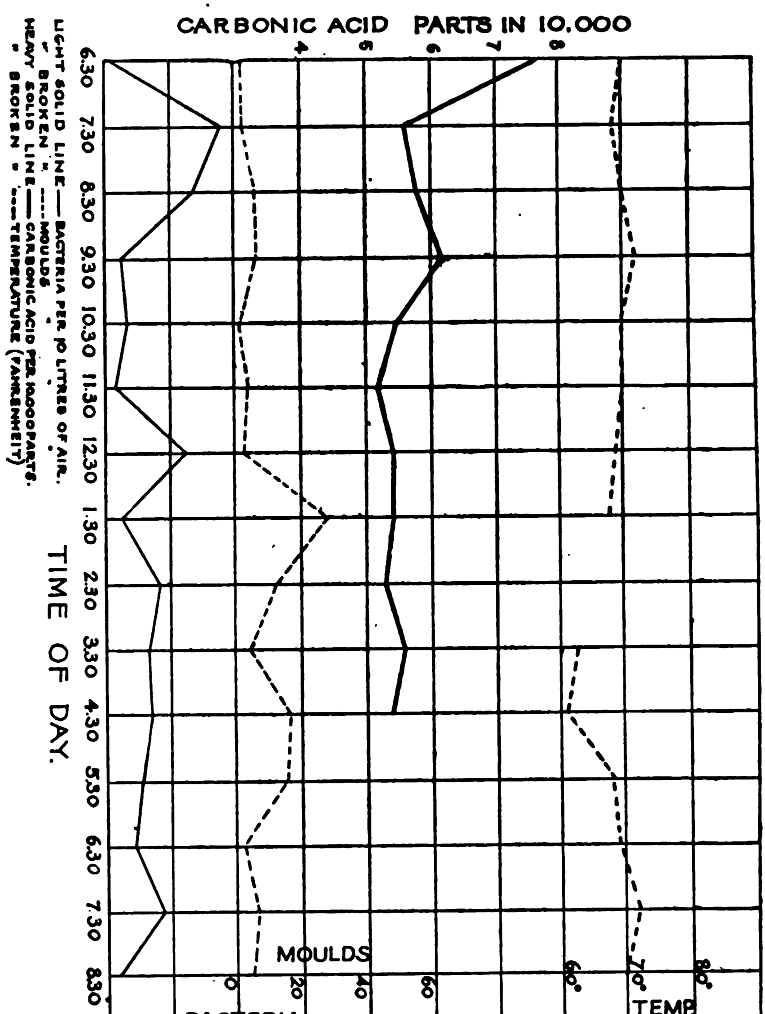
Time.	Temperature, Degrees.	Carbonic Acid.	Bacteria.	Moulds.	Remarks.
A.M.					
6.30	74	7.63	21	3	
7.30	72	6.74	26	19	
8.30	72	6.69	25	10	Ward in disorder; making beds; floor dirty; very close; opened end window.
9.30	68		19	17	Ward swept about 9.
10.30	70	9.00	30	8	
11.30	68	8.90	72	4	Surgeon's visit between 10 and 11; all dressings changed.
P.M.					
12.30	70	6.38	3	15	Patients eating dinner.
1.30	70	5.01	9	31	
2.30	70	5.70	13	4	End door closed.
3.30	72	8.39	18	8	End door open.
4.30	70	4 88	2	6	Supper brought in.
5.30	75	8.31	7	6	Gas lighted.
6.30	74	8.32	13	15	Dressed amputation.
7.30	74	6.24	18	6	Much walking about; patients preparing for bed.
8.30	70	6.49	3	1	Lights turned down at 7.45.
Average, .		7.05	18.6	10.4	
Outside air,		4.17	–	–	


CARBONIC ACID PARTS IN 10000
MOULDS
BACTERIA
TEMP.
TIME OF DAY.
WARD F.

Ward P (Surgical Ward, Male). Feb. 1, 1889.

Time.	Temperature, Degrees.	Carbonic Acid.	Bacteria.	Moulds.	Remarks.
A.M.					
6.30	75	7.54	21	0	Several patients up.
7.30	74	6.09	26	2	Breakfast served.
8.30	72	5.63	67	17	Sweeping floor; cold-air inlets opened a little.
9.30	70	5.39	0	5	Ward in good order.
10.30	72	5.95	12	2	Ward in good order.
11.30	70	5.49	8	2	Some draught.
P.M.					
12.30	70	6.12	5	1	Second sweeping finished.
1.30	68	5.47	1	3	Quiet.
2 30	66	5.51	9	6	Fifteen visitors present.
3.30	63	5.01	2	2	
4.30	65	4.98	4	13	Very quiet.
5.30	65	6.04	9	13	Fifteen gas jets burning.
6.30	66	5.56	3	2	Very quiet.
7.30	66	6.21	11	2	Very quiet.
8 30	68	4.19	3	2	Lights out.
Average,		5.68	12	4.7	
Outside air,		4.45	-	-	

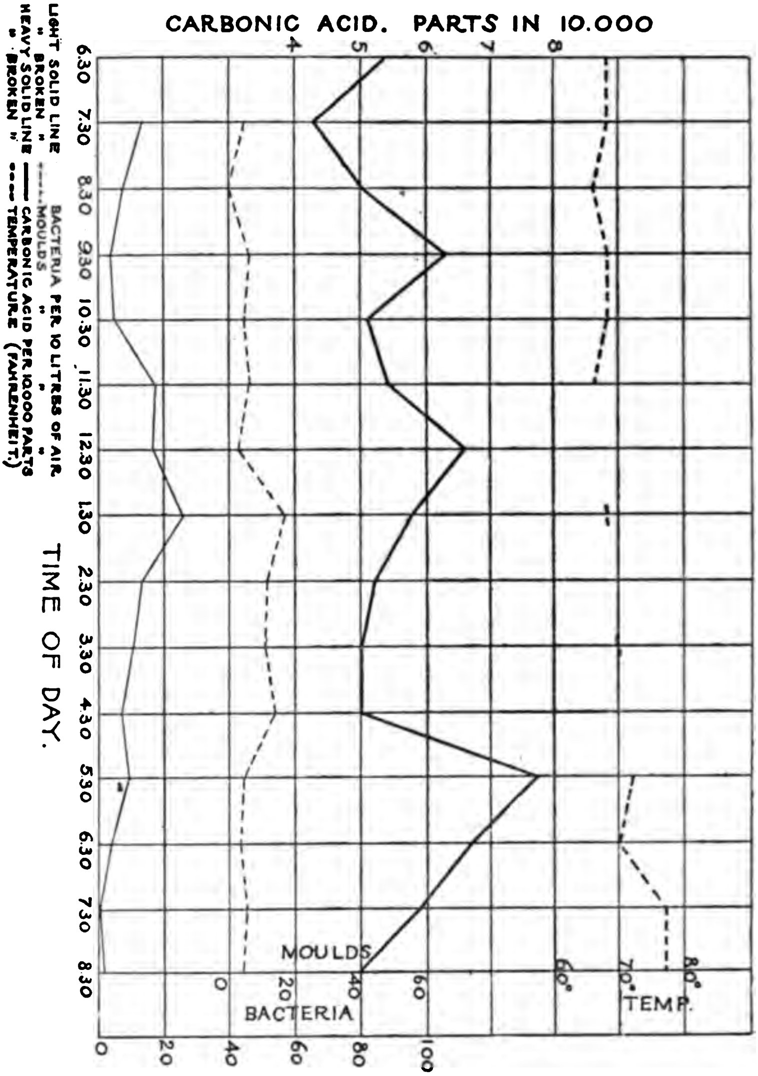
WARD T.


CARBONIC ACID PARTS IN 10.000
4 5 6 7 8
6.30 7.30 8.30 9.30 10.30 11.30 12.30 1.30 2.30 3.30 4.30 5.30 6.30 7.30 8.30
TIME OF DAY.
MOULDS
0 20 40 60
BACTERIA
0 20 40 60 80 100
TEMP.
60° 70° 80°
LIGHT SOLID LINE — BACTERIA PER 10 LITRES OF AIR.
" BROKEN " --- MOULDS "
HEAVY SOLID LINE — CARBONIC ACID PER 10,000 PARTS.
" BROKEN " --- TEMPERATURE (FAHRENHEIT)

Ward T (Medical Ward, Male). Feb. 2, 1889.

Time.	Temperature, Degrees.	Carbonic Acid.	Bacteria.	Moulds.	Remarks.
A.M.					
6.30	70	7.67	3	2	
7.30	69	5.63	35	2	Making beds.
8.30	70	5.77	27	6	Making beds.
9.30	72	6.16	5	6	Felt close; ventilators in ceiling closed.
10.30	70	5.49	7	1	Felt fresher; quiet.
11.30	70	5.21	3	4	Quiet.
P.M.					
12.30	69	5.39	25	3	Some walking about.
1.30	68	5.35	5	28	Some walking about.
2.30	-	5.36	17	12	Some walking about.
3.30	63	5.56	13	4	Taking temperature; cold; closed two ventilators in ceiling.
4.30	61	5.44	14	16	Supper brought; closed all ceiling ventilators but one.
5.30	68	-	11	15	Fifteen gas jets burning; some work.
6.30	69	-	9	2	Pretty quiet.
7.30	72	-	18	6	Quiet.
8.30	70	-	3	4	Quiet.
Average, .		5.72	13	7 4	

WARD E.


CARBONIC ACID. PARTS IN 10.000
4
5
6
7
8
6.30
7.30
8.30
9.30
10.30
11.30
12.30
1.30
2.30
3.30
4.30
5.30
6.30
7.30
8.30
TIME OF DAY.
MOULDS
0
20
40
60
BACTERIA
0
20
40
60
80
100
60°
70°
80°
TEMP.
LIGHT SOLID LINE BACTERIA PER 10 LITRES OF AIR.
" BROKEN " MOULDS " "
HEAVY SOLID LINE CARBONIC ACID PER 10000 PARTS
" BROKEN " TEMPERATURE (FAHRENHEIT.)

Ward E (Contagious Ward, Diphtheria). Jan. 26, 1889.

Time.	Temperature, Degrees.	Carbonic Acid.	Bacteria.	Moulds.	Remarks.
A.M.					
6.30	68	5.88	no	count	E, South.
7.30	68	4.28	13	5	Making beds; ward swept; E, North.
8.30	66	5.00	7	0	E, South.
9.30	68	6.25	3	6	E, North.
10.30	68	5.12	4	5	Mopping floor; E, South.
11.30	66	5.44	17	6	Mopping floor; E, North.
P.M.					
12.30	-	6.58	6	3	E, South.
1.30	68	5.83	26	17	E, North.
2.30	-	5.17	12	11	
3.30	70	5.04	10	11	
4.30	-	5.02	7	14	
5.30	72	7.65	9	5	
6.30	70	6.67	3	3	
7.30	77	5.91	0	5	
8.30	77	4.97	1	4	
Average, .		5.06	7.2	6.4	
Open air, .		3.89			

Carbonic Acid and Micro-organisms.

Hourly determinations of carbonic acid in the nine wards examined show a most satisfactory condition.* According to the standard usually adopted, the ventilation in all the wards examined is good, and in most of them perfect.

Although no relation exists between the amount of carbonic acid and the number of micro-organisms found in individual experiments, the wards which showed the best average results in carbonic acid are also freest from micro-organisms.

Moulds.

Heretofore, but little has been said concerning moulds, bacteria being, from a sanitary point of view, of much more importance. There are fewer moulds present in the air of the wards than bacteria, and they fail to fall into line with them in their distribution throughout the day. On the whole, they fluctuate more than bacteria, and the cause of a sudden increase or decrease in numbers is not so easily traced to causes within the room. The stirring up of the dust by sweeping and bed-making does not appear to materially increase their number, for where an increase in bacteria from such causes is most marked, the moulds are conspicuously absent; when an increase does appear to be due to sweeping, etc., the rise in numbers always follows later than the bacteria. The fact that these large disturbances do not increase the number of moulds, shows that they have not subsided, and illustrates the well-known fact that moulds are relatively lighter than bacteria, and consequently do not settle out so readily. The great buoyancy of moulds is also shown by the determinations made in the basements, where disturbing influences seldom enter, and yet comparatively large numbers were always found suspended in the air.

While the bacteria are distinctly greater in numbers during the morning, moulds, on the other hand, show a tendency to increase in the afternoon; thus, in the nine wards examined by hourly experiments, the moulds in six predominate in the afternoon. It is probable that the moulds, being so light, are kept suspended longer in the upper por-

* Pettenkoffer's method was employed in all determinations of carbonic acid.

tions of the room by the commotion of the morning. This condition being removed, the tendency is to fall; but if met by air currents of sufficient force, they again take an upward course, and thus cause the fluctuations so frequently met with.

Conclusions.

The results obtained from buildings of the hospital group occupied by employees, investigated for the sake of comparison with the wards, taken together with the results furnished by outside air, furnish abundant proof that the air of the hospital is remarkably free from micro-organisms. Whether the numbers found are greater or less than would be found in similar institutions, is not known. So far as I am familiar with the work of other investigators in this field, the results show that hospitals of this class, as compared with other buildings, will take first rank in the freedom of their air from micro-organisms.

This is as it should be: bacteria, in a way, represent so much dirt. In a well-managed hospital, one has an approach to an ideal degree of cleanliness, and in no class of buildings is the same care taken to secure freedom from dirt as is taken in such a hospital. Undoubtedly, the systematic, thorough renovation which is going on continually in the hospital, is of great importance in removing accumulations of germs, which must inevitably occur in the wear and tear of a building. This hospital is particularly fortunate in this respect; with its large tent service, wards in turn can be vacated during the summer months, and put in thorough repair, to an extent not otherwise possible.

In this connection, it will be interesting to reproduce some valuable tables prepared by Prof. Thos. Carnelly and his colleagues,* showing the number of micro-organisms in the air of clean and unclean buildings in Dundee.

	Bacteria in 10 litres of air.
One-roomed houses, clean,	180
" " dirty,	410
" " dirtier,	490
" " very dirty,	930

* I take great pleasure in referring the reader interested in this subject to the work of Carnelly, it being the first attempt, so far as I am aware, to systematically determine the number of micro-organisms in the air of buildings.

	Bacteria in 10 litres of air.
Naturally ventilated schools, cleaner,	910
" " " average cleanliness,	1,250
" " " dirtier,	1,980
Mechanically ventilated schools, cleanest,	30
" " " clean,	160
" " " less clean,	300

These results leave no doubt that the cleanliness of rooms and of persons also is of the greatest importance in preventing accumulations of micro-organisms. It will be noticed that the numbers found in mechanically ventilated schools are far less than for those ventilated naturally; but the results as a whole, both in schools and dwelling-houses, are enormous, as compared with those obtained in this hospital. On the other hand, Carnelly found in the wards of the Dundee Royal Infirmary, between 4 and 5 o'clock P.M., from ten to twenty bacteria. Neumann (Vierteljahrsschrift f. gerichliche Medicin, 1886. B. 14, p. 30) made thirty-five experiments by Hesse's method. At different elevations, from 1.40 to 3.20 metres, about the same number of organisms were found. In the morning, after sweeping, 10 litres of air gave from 80 to 140 bacteria, while four consecutive determinations at the same height showed a gradual decrease; the last examination, at 8 P.M., giving from 4 to 10 bacteria.

The results obtained in both the above hospitals are in perfect accord with those obtained in this investigation.

The extent of vitiation which the air of dwelling-houses may reach is further shown by determinations made by Carnelly, on one, two and four roomed houses, between 12.30 and 4.30 A.M.

	Bacteria.	Moulds.
One-roomed houses,	580	12
Two-roomed houses,	430	22
Four-roomed houses, and more,	160	10

When it is remembered that the air of the Boston City Hospital is practically free from bacteria at the hour of midnight, the above results, representing the condition of the air breathed by human beings, is certainly startling, and goes far to show the value of the information furnished by such determinations. The atmosphere of a building vitiated by micro-organisms can be so readily brought at least to a moderate state of purity, by a proper degree of cleanliness and oversight, that there is no legitimate reason why the air of public buildings should reach the condition of vitiation shown by Carnelly's experiments, in certain buildings in Dundee.

In any comparison of the number of micro-organisms found in the air of a hospital with those of other buildings, allowance must of course be made for the fact that a very small number of organisms found in hospital air, if pathogenic, might be more dangerous than large numbers of non-pathogenic forms found elsewhere. The great majority of micro-organisms found in air are probably harmless; but their functions as yet are so imperfectly understood, that it would seem unwise to consider them entirely harmless. Many of them evince a power in the decomposition of the various culture media, which is suggestive of what might happen in or upon the human system, should they find there a suitable *nidus* for development. Although no attempt was made in this investigation, except in a very general way, to determine the character of the germs present, it was found that the same species which occurred in the outside air were met with in the hospital; but certain species were met with in the hospital that were not found in outside air. In the ward devoted to diphtheria, species were always fewer in number than elsewhere, and the colonies were not unlike those obtained from the material furnished by the patients themselves, although no proof of their identity was obtained. The presence of pathogenic bacteria has frequently been demonstrated in the air of hospital wards; for example, Cornet, of Koch's Hygienic Institute, found bacilli tuberculosis in fifteen out of twenty-one wards in seven hospitals in Berlin, and out of ninety-four animals inoculated, twenty died of tuberculosis. Von Eiselsberg (Langen-

beck's Archiv. B. 35, heft. 1), in an erysipelas room of the hospital, found erysipelas cocci; also, in a surgical ward, where wounds were treated under aseptic precautions, the presence of Staphylococcus Pyogenes Aureus was demonstrated. Emmerich (Deutsch. Med. Wochenschrift, 1887, No. 3) not only found erysipelas cocci in the air of an old dissecting room, but also in the plastering and walls and ceiling.

In this connection, it should be stated that the ordinary methods employed in the cultivation of the germs of the air would fail to reveal the presence of certain pathogenic bacteria, as, for example, bacilli tuberculosis; such forms, however, are not difficult to determine by special means. Pathogenic bacteria are as likely to exist in this hospital as in any other, and probably do exist; but it is worthy of note that the general health of employees is excellent, that contagious diseases are seldom contracted by them, or by patients themselves, although isolated cases occasionally occur.

The importance of obtaining definite information regarding the dangerous or innocuous character of micro-organisms found in the atmosphere is evident; but, until methods are so amplified that species can be identified with a greater degree of certainty and far less expenditure of time than at present, we must be content with a determination of the number and distribution of bacteria in the air of buildings.

Carnelly has proposed a standard for the air of dwellings and schools; *i.e.*, twenty micto-organisms per litre, or two hundred per ten litres (excess over outside air), — numbers so greatly in excess of all results obtained in this hospital as to make evident the necessity of a standard for various classes of buildings.

The air of this hospital compares favorably with the external air. In the absence, then, of a standard of purity for hospital air, it would not be unreasonable to require that the number of micro-organisms in the air of a ward should but slightly exceed the numbers found in outside air.

In conclusion, the writer wishes to express his gratitude to the trustees of the hospital for aid in carrying on this work, and to the superintendent, Dr. Rowe, for encouragement in the undertaking.

SUMMARY

OF THE

MORTALITY REPORTS

OF

MASSACHUSETTS CITIES AND TOWNS.

A SUMMARY

OF

THE MORTALITY REPORTS OF THE MASSACHUSETTS CITIES AND TOWNS.

The following summary is compiled from the returns which are forwarded to the office of the State Board of Health each week by the registrars or boards of health of cities, and by the town clerks of such towns as are willing to contribute the desired information.

This work has been continued for nearly twenty years in a similar manner, and more recently the weekly report has been published in the form of a bulletin, and distributed to each city and town in the State. A summary of the report, or at least such part of it as relates to the cities, is also published weekly in one of the daily papers of Boston, and also in the "Boston Medical and Surgical Journal" of each week.

This report is a partial one, and includes the mortality statistics of a portion only of the State; the portion which makes no return consisting mainly of the smaller towns, in which the individual returns of death, from which the report is made up, are not so promptly and carefully carried out as they are in the cities.

It is unlike the registration report, in that the latter is required by statutory provisions, and is therefore presumably complete in its details, and includes many facts which the weekly mortality reports do not embrace, — such as age, sex and residence.

On the other hand, the mortality reports show a continuous history of the mortality from the principal infectious diseases for a series of years, by months and weeks, indicating their

prevalence at different seasons of the year, and affording a comparison of the mortality at different seasons with the prevailing meteorological conditions.

No statement of mortality rates has definite value which is not based upon a correct estimate of the population. Such estimates must be computed from the census, which is made every five years, either by the State or by the general government; and the estimates for each successive year after a census year have a variable probability of error, — such probability increasing in proportion as the distance in time from the census year increases.

The number of reporting towns in 1888 has been somewhat less than those of 1887; and in estimating the population of the reporting cities and towns, the increase of population may be reckoned as a balance to the diminished number which have contributed to the report during the year. The average number of the reporting population may therefore be taken as 1,100,000 for 1888.

General Summary.

DATE.	Barometer.	Maximum Ther-mometer. Mean for ea. week.	Minimum Ther-mometer. Mean for ea. week.	Rain — Inches.	Humidity. Mean for ea. week.	Total Deaths.	Deaths under 5.	Infectious Diseases.	Consumption.	Acute Lung Diseases.	Typhoid Fever.	Diarrhœal Diseases.	Scarlet-Fever.	Measles.	Diphtheria and Croup.	Puerperal Fever.	Whooping Cough.	Malarial Fever.	Small-pox.	Erysipelas.	Death-rates per 1,000.
1888.																					
Jan. 7,	30.019	39	22	.84	77.3	538	157	64	64	93	6	2	14	1	25	-	4	3	-	4	24.91
14,	30.283	31	15	.44	70.3	448	131	58	54	97	3	4	22	2	21	1	2	-	-	-	23.87
21,	30.403	27	11	.59	69.9	557	149	64	77	125	8	2	14	-	27	2	2	-	-	2	27.53
28,	29 977	19	0	.39	66.7	556	174	85	65	103	7	7	18	-	34	2	6	-	-	2	25.16
Feb. 4,	29,967	29	12	.82	76.6	533	172	62	75	101	4	6	14	1	30	-	5	-	-	-	23.45
11,	30.100	37	15	Trace	66.3	509	148	51	59	106	2	2	7	2	23	-	4	1	-	4	22.90
18,	30.097	37	16	.25	73.	494	154	56	55	110	8	2	7	2	53	1	3	-	-	3	23.20
25,	30.291	44	29	1.21	75.7	506	154	62	64	91	7	6	12	-	24	-	7	-	-	1	24.03
March 3,	30.057	35	17	.01	63.7	527	163	63	74	102	10	3	10	2	22	3	4	-	-	1	24.59
10,	29.993	35	19	-	65.	527	152	66	77	92	8	3	14	-	29	-	3	-	1	2	24.37
17,	29.767	31	29	1.24	76.3	480	132	60	60	92	2	8	9	-	22	3	4	-	-	5	22.58
24,	29.950	37	25	.82	64.	464	144	57	70	89	8	3	9	-	22	2	2	-	-	4	21.01
31,	30.151	44	30	1.18	70.9	445	121	52	67	78	2	6	8	1	19	-	8	-	-	2	23.02
April 7,	30.500	50	33	1.26	62.	429	122	37	60	65	7	4	5	1	14	1	2	1	-	1	19.64
14,	30.149	49	29	.52	58.7	476	140	59	76	84	8	5	5	2	27	1	5	-	-	2	22.90
21,	29.970	55	36	.26	61.8	508	140	49	76	87	8	3	4	-	23	2	4	-	-	-	21.86
28,	30.211	53	38	-	50.4	383	92	51	66	55	5	2	11	-	24	-	-	1	1	3	20.87
May 5,	30.054	67	40	.31	75.	521	155	73	79	85	4	15	9	1	31	2	-	-	1	4	23.43
12,	30.073	57	46	2.36	71.3	398	128	46	59	55	8	1	2	4	26	-	-	-	-	3	19.61
19,	29.934	62	43	1.58	77.	414	121	57	67	57	5	4	4	3	32	-	1	-	-	3	20.51
26,	30.097	66	49	.26	65.3	386	92	40	72	38	2	6	3	2	20	1	1	-	-	1	19.22
June 2,	29.869	80	53	.87	78.1	424	130	66	68	66	8	7	6	5	26	2	1	-	2	4	19.62
9,	30.027	76	54	.23	60.6	418	110	59	58	42	5	6	-	1	28	1	1	-	-	2	19.78
16,	29.920	79	57	1.17	69.	389	90	35	62	34	5	7	1	1	19	-	-	-	-	-	18.65
23,	29.840	73	62	.29	70.	347	102	35	45	34	5	7	1	1	14	-	4	1	-	-	17.79
30,	29.920	78	58	.96	74.	417	136	71	50	27	5	22	5	3	24	-	4	-	-	2	18.20
July 7,	29.950	75	59	.11	63.	354	128	59	50	24	1	28	2	4	13	1	5	1	-	-	15.89
14,	29.610	69	60	-	56.	331	120	86	48	16	5	53	1	-	16	1	5	1	-	1	21.33
21,	30.160	78	65	.70	73.6	443	124	132	56	14	6	98	1	2	12	-	2	-	-	1	27.58
28,	30.020	81	61	1.72	74.	578	312	236	68	22	8	195	2	5	16	-	3	-	1	1	27.82

General Summary. — Concluded.

DATE.	Barometer.	Maximum Thermometer. Mean for ea. week.	Minimum Thermometer. Mean for ea. week.	Rain — Inches.	Mean Humidity. for ea. week.	Total Deaths.	Deaths under 5.	Infectious Diseases.	Consumption.	Acute Lung Diseases.	Typhoid Fever.	Diarrhœal Diseases.	Scarlet-Fever.	Measles.	Diphtheria and Croup.	Puerperal Fever.	Whooping Cough.	Malarial Fever.	Small-pox.	Erysipelas.	Death-rates per 1,000.
1888.																					
Aug. 4,	29.910	79	62	.26	67.	584	323	213	48	12	5	173	-	1	10	-	5	-	-	-	26.21
11,	30.030	80	61	1.04	67.	549	273	234	60	14	15	196	-	1	15	3	5	-	-	5	27.24
18,	29.570	78	63	1.81	76.	514	270	213	51	16	9	173	1	-	14	-	6	-	-	5	25.27
25,	29.910	78	60	3.42	63.	524	253	179	65	12	12	136	2	-	14	-	3	2	-	-	27.05
Sept. 1,	29.910	77	60	.21	70.	533	241	186	39	14	14	155	1	1	13	-	3	1	-	2	21.06
8,	30.130	69	54	.26	71.	420	188	117	45	31	16	87	1	-	12	-	3	1	-	-	24.99
15,	30.050	70	59	1.73	74.	447	206	117	58	15	13	78	2	1	10	-	6	-	-	-	24.43
22,	30.100	63	56	2.45	89.	490	215	128	61	27	19	85	3	1	12	-	2	-	2	-	20.97
29,	29.960	61	47	3.12	77.	437	199	104	42	34	19	62	3	-	15	-	1	-	-	1	21.18
Oct. 6,	29.460	57	43	.67	73.	431	157	90	61	33	28	39	2	1	17	-	2	-	-	-	21.28
13,	29.730	55	41	1.15	73.	462	151	58	67	37	28	26	1	-	22	-	4	-	-	-	21.79
20,	29.970	53	41	.53	74.	440	114	81	64	43	28	20	4	-	23	-	2	1	-	-	19.67
27,	31.590	52	39	.86	71.	414	126	64	60	44	21	8	3	2	24	1	1	-	-	2	19.72
Nov. 3,	30.020	62	45	2.30	65.	378	112	52	52	38	11	15	1	2	19	-	-	-	-	-	18.34
10,	30.090	59	44	1.32	75.	391	108	63	67	59	11	10	3	-	35	-	1	-	-	-	17.75
17,	30.140	53	36	.60	66.	356	95	57	43	43	13	8	3	3	28	-	-	-	-	-	17.87
24,	30.540	36	22	.34	70.	344	107	47	51	35	10	3	-	1	28	-	1	-	-	1	18.47
Dec. 1,	29.710	47	36	2.68	62.	372	103	51	59	47	14	14	1	-	24	-	-	-	-	1	17.22
8,	29.910	43	29	.01	67.	332	82	31	52	43	9	2	2	1	15	2	-	-	-	-	17.95
15,	29.920	33	24	1.16	70.	343	101	45	50	39	7	2	2	-	29	1	2	-	-	1	18.64
22,	29.890	36	23	2.98	71.	357	95	42	55	48	4	2	1	1	30	-	2	-	-	-	17.95
29,	30.140	49	33	.23	62.	341	125	43	61	65	6	2	4	3	23	-	2	-	-	-	20.91
Total,	-	-	-	-	-	23,259	7,887	4,196	3,121	2,833	482	1,813	260	65	1,248	33	139	14	8	76	-
Weekly average,	-	-	-	-	-	447	150.7	80.7	60.	54.3	9.27	34.9	5.	1.25	24.	.65	2.67	.27	.15	1.46	21.23
Ratio per 1,000 deaths,	-	-	-	-	-	-	336.9	180.4	134.2	121.8	20.7	77.9	11.2	2.8	53.6	1.5	5.9	.06	0.3	3.3	-

Reporting population about 1,100,000.

The data embraced in this report are as follows: —

Average height of barometer for each week.	Deaths from consumption.
Mean of daily maximum temperature.	acute lung diseases.
Mean of daily minimum temperature.	typhoid fever.
Rainfall expressed in inches.	diarrhœal diseases.
Humidity.	scarlet fever.
Total deaths for each week reported.	measles.
Deaths of children under five years.	diphtheria and croup.
Deaths from infectious diseases.	puerperal fever.
	whooping cough.
	malarial fever.
	small-pox.
	erysipelas.

Total Deaths.

The whole number of deaths reported for the year 1888, from the cities and towns which contributed returns, was 23,259, and the average number per week was 447. The greatest number of deaths reported in a single week was 584, in the week ending August 4; and the least number reported was 331, for the week ending July 14 (the least number in 1887 being reported for the week ending June 18). The weekly average number reported for each month was as follows: —

January,	525	July,	426
February,	511	August,	543
March,	489	September,	465
April,	499	October,	437
May,	430	November,	367
June,	399	December,	349

The months in which the greatest number of deaths were reported were August, January and February; and those in which the least number were reported were June, November and December. Of the total number of deaths reported

(23,259), the percentages of mortality in each quarter of the year were as follows: —

	All Ages.		Ages Under Five Years.	
	Numbers.	Percentages.	Numbers.	Percentages.
First Quarter, . . .	6,584	28.31	1,951	24 90
Second Quarter, . .	5,510	23.69	1,558	19.88
Third Quarter, . .	6,204	26.67	2,852	36.39
Fourth Quarter, . .	4,961	21.33	1,476	18.83
	23,259	100.00	7,837	100.00

Deaths under Five Years.

The number of deaths reported of persons under five years of age was 7,837, and the weekly average for the year was 151.

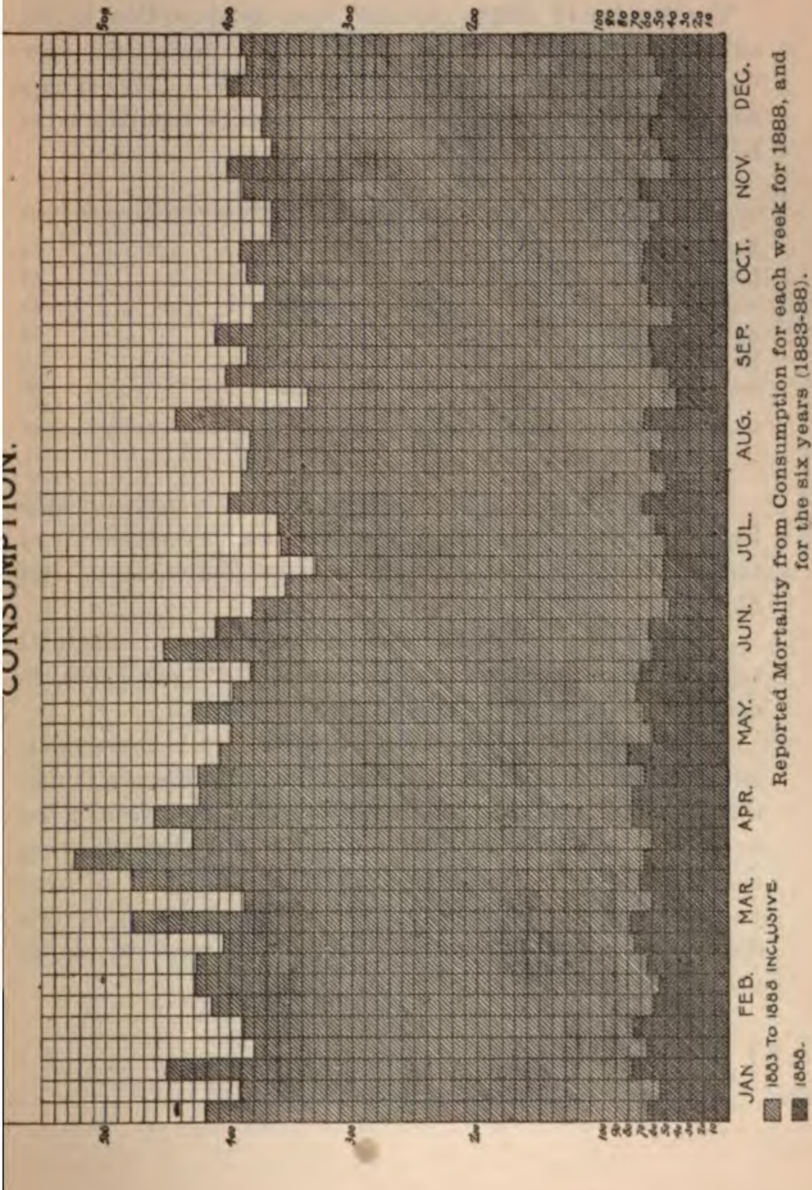
The greatest number of deaths of this class reported in any single week was 323, for the week ending August 4; and the least number 82, for the week ending December 8.

The ratio of reported deaths of children under five years of age to the total number of deaths was 33.69 per cent., or one in 2.9, which was less than that of 1887 (36.6), and nearly the same as that of 1886 (33.9). The average weekly number of reported deaths of children under five years of age for each month was as follows: —

January, ...	153	July, ...	171
February, ...	157	August, ...	280
March, ...	142	September, ...	210
April, ...	123	October,.	137
May, ...	124	November, ...	105
June, ...	114	December, ...	101

The months in which the greatest number of deaths of children under five years of age was reported were July, August and September; and those in which the least number was reported were June, November and December.

CONSUMPTION.



Reported Mortality from Consumption for each week for 1888, and for the six years (1883-88).

Consumption.

The number of deaths reported from consumption in the cities and towns contributing to this report during the year was 3,121, and the weekly average was 60. The average weekly number of deaths reported for each month was as follows: —

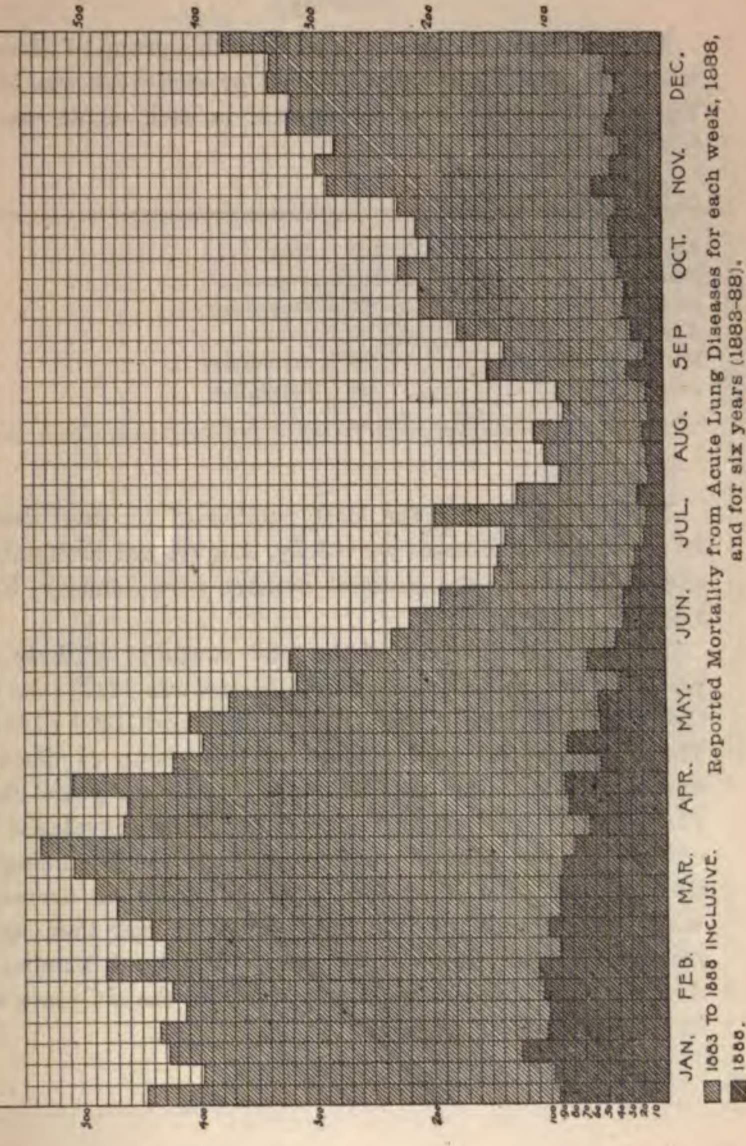
January,	65	July,	55
February,	63	August,	56
March,	70	September,	49
April,	69	October,	63
May,	69	November,	53
June,	57	December,	55

The months having the least number of reported deaths from this disease were July, November and December; and those having the greatest number were March, April and May.

The ratio of reported deaths from consumption to the total reported mortality from all causes was 134.2 per 1,000, as compared with 141.1 in 1887 and 156.5 in 1886.

In the present report is given a diagram in which are tabulated the results of six years' observation of the distribution of this disease throughout the year, by months and weeks; the total number of deaths from consumption in the reporting cities and towns in these six years being 20,869. In three years out of six, the greatest number of deaths from this disease in any week occurred in the last week of March (1883, 1886 and 1887).

ACUTE LUNG DISEASES.



Reported Mortality from Acute Lung Diseases for each week, 1888, and for six years (1883-88).

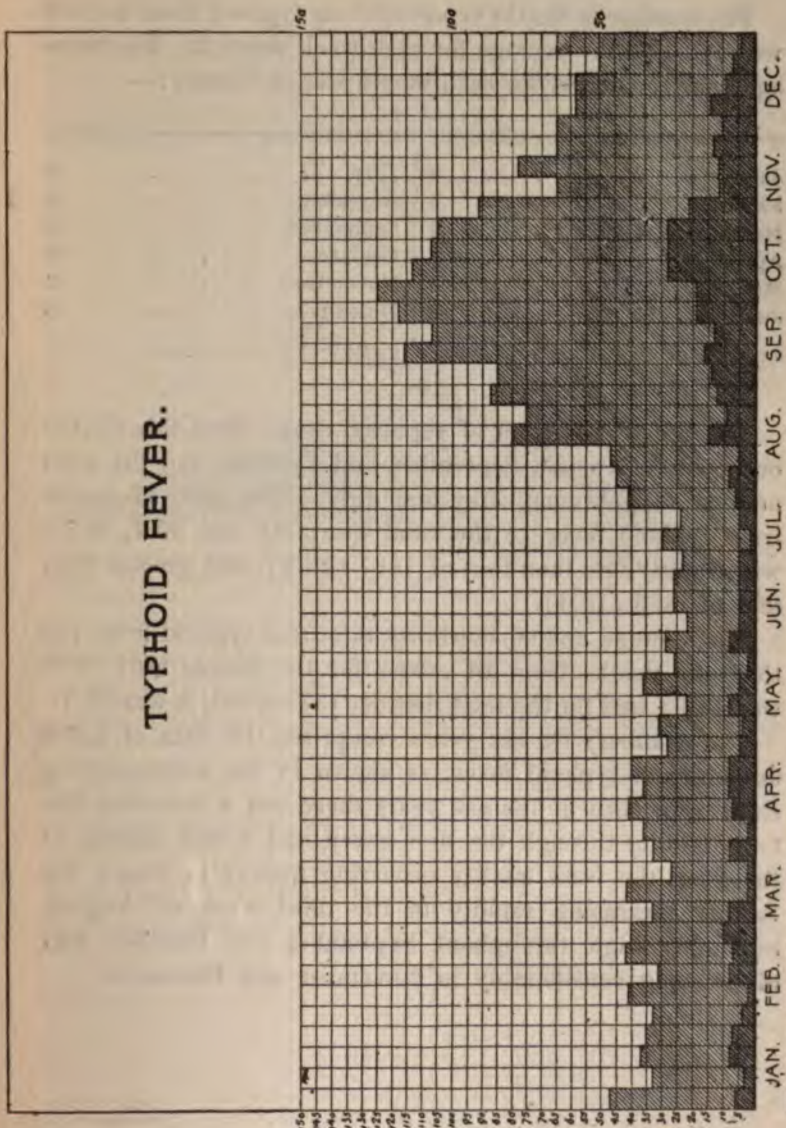
Acute Lung Diseases (Pneumonia, Bronchitis, Asthma and Pleurisy).

The number of deaths reported from this group of diseases was 2,833, and the average number for each week was 54.5. The weekly average number reported in each month was as follows: —

January,	104	July,	19
February,	102	August,	13
March,	91	September,	24
April,	73	October,	39
May,	59	November,	44
June,	41	December,	48

The months having the least number of reported deaths from acute lung diseases were July, August and September, and those having the greatest number were January, February and March.

The ratio per thousand of the total mortality of those reported as having died from these diseases was 121.8; for the two previous years it was 107.3 (1887) and 102.4 (1886). The variations in the incidence of this group of diseases upon the population are illustrated in the six years' chart (1883–1888), wherein it appears that their prevalence increases with considerable uniformity from the beginning of the year until the last week in March, and then decreases with quite a uniform rate until August; and then again increases to the close of the year. The least number of deaths from these causes in any week for the six years was in the last week of August.



1883 TO 1888 INCLUSIVE.
1888.

Reported Mortality for each week from Typhoid Fever, 1888, and six years (1883-88).

Typhoid Fever.

The number of deaths reported from typhoid fever in 1888 was 482, and the average for each week was 9.3. The average weekly number for each month was as follows: —

January,	6	July,	5
February,	5	August,	10
March,	6	September,	16
April,	7	October,	26
May,	5	November,	11
June,	6	December,	8

The greatest number of reported deaths from this disease occurred in August, September and October, and the least number in February, May and July. The ratio of deaths from typhoid fever to the total mortality was 20.7, which was slightly less than that of 1887 (20.9), and greater than that of 1886 (18.4).

The average annual mortality rate from typhoid fever per thousand deaths from all causes for the decade 1861–1870 was 46.9; and for the next decade, 1871–1880, it was 31.7.

The summary for six years comprises the data of 2,806 deaths from typhoid fever, as shown in the accompanying chart. In each of the six years there was a tolerably uniform fatality through the first seven and a half months of the year, the least fatality occurring usually in June; the fatality increasing rapidly in the third week of August, remaining high throughout September and October, and diminishing considerably in November and December.

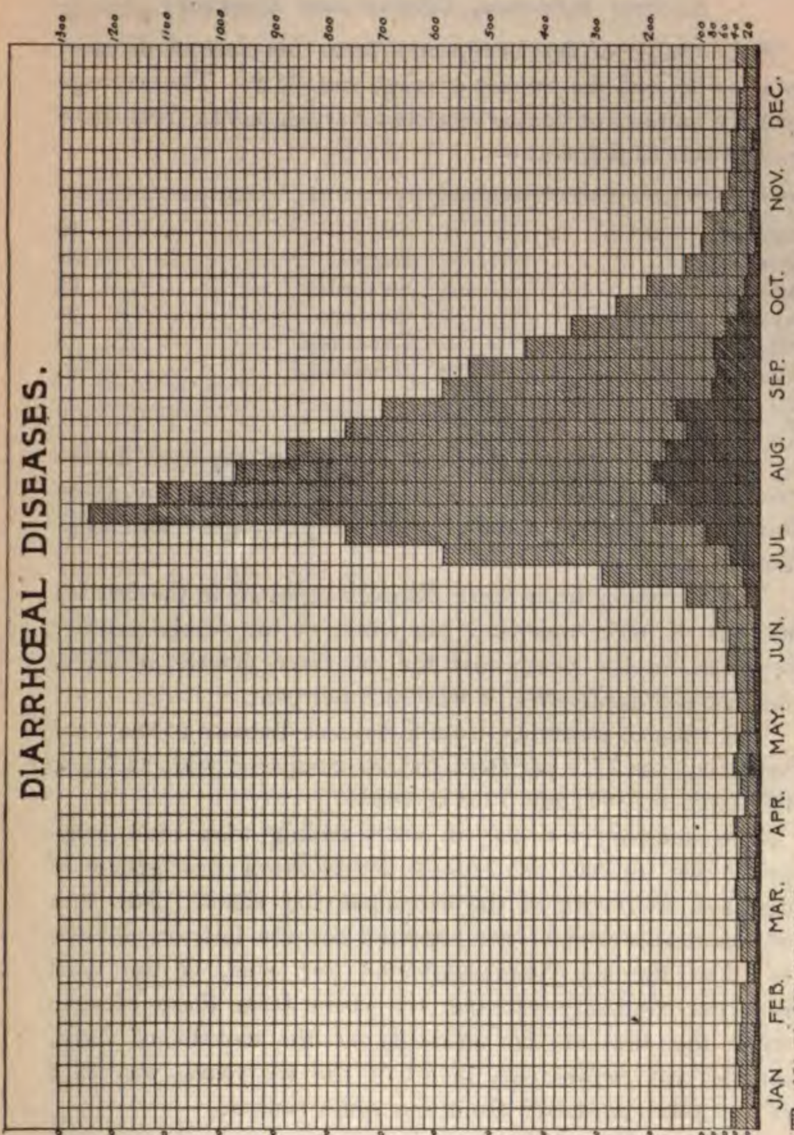


Chart showing reported Mortality from Diarrhœal Diseases for each week, 1888, and six years (1883-88).

Diarrhœal Diseases (including Diarrhœa, Dysentery, Cholera Infantum, Cholera and Enteritis).

The number of deaths reported from this class of diseases was 1,813, and the weekly average was 34.9. The average weekly number of deaths reported in each month from these causes was as follows: —

January,	4	July,	93
February,	4	August,	169
March,	5	September,	93
April,	3	October,	23
May,	6	November,	9
June,	10	December,	4

The months having the least number of reported deaths were January, February, April and December; and those having the greatest number were July, August and September.

The mortality from these diseases reported in the last six months of 1888 was 92.1 per cent. of the whole number reported for the year; and for the three months of July, August and September, it was 83.8 per cent.

The ratio of mortality from diarrhœal diseases to the total mortality was 77.9 per thousand, as compared with 82.5 per thousand in 1887, and 77.2 in 1886.

The summary for the six years ending with 1888, comprises the returns of 11,634 deaths from this group of diseases, as shown in the accompanying chart. The sum of the deaths which were reported for the last six months of all of the six years was 90.1 per cent. of the total reported mortality for the six years from these causes; while the sum of the mortality of the months of July, August and September, in all of the six years, was 79.9 of the total mortality from the same causes.

The mortality of the first six months remained quite uniform, and comparatively low, until the last week of June; from which time it very rapidly increased until the last week of July, and then diminished at a less rapid rate until the first week of November.

The deaths for each week for the six years (1883–1888) from consumption, acute lung diseases, typhoid fever and diarrhœal diseases, were as follows: —

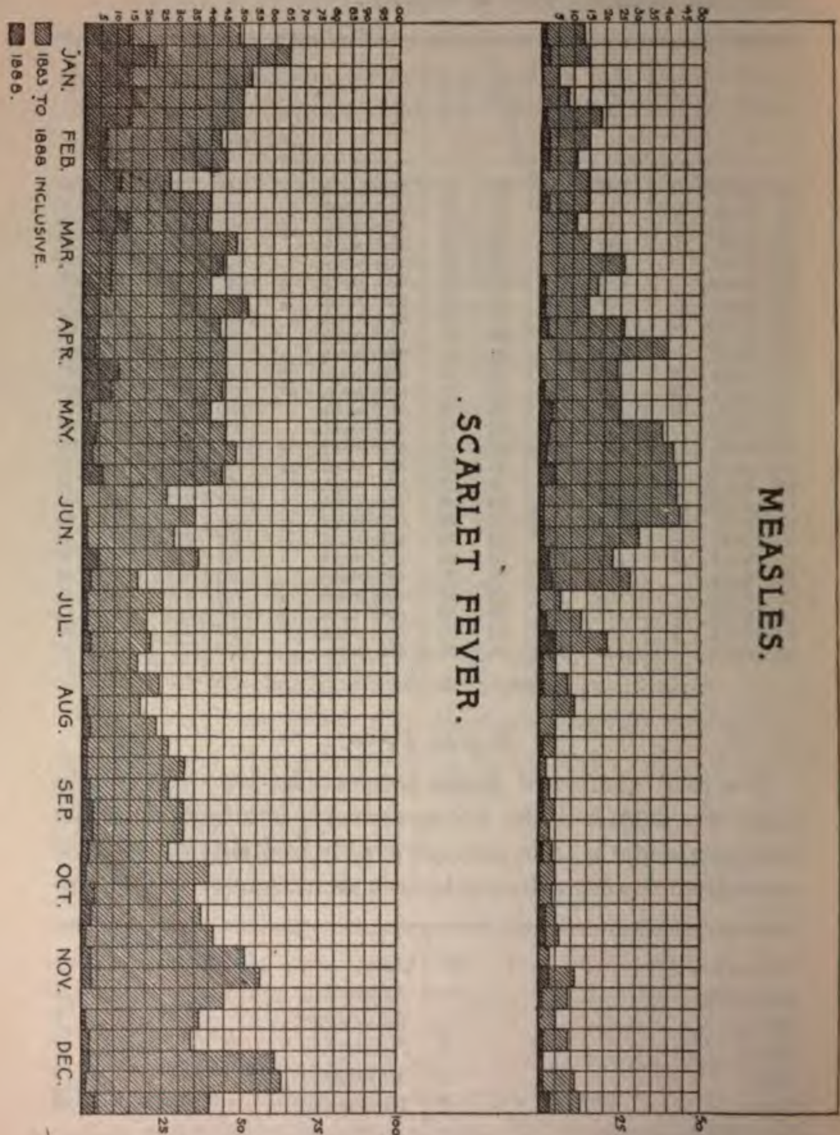
		Consumption.	Acute Lung Diseases.	Typhoid Fever.	Diarrhœal Diseases.			Consumption.	Acute Lung Diseases.	Typhoid Fever.	Diarrhœal Diseases.
1st week,		420	446	47	50	27th week,		328	142	23	294
2d week,		392	398	33	29	28th week,		357	137	30	588
3d week,	Jan.	452	428	37	33	29th week,	July.	360	199	24	776
4th week,		380	435	35	39	30th week,		401	126	41	1,252
5th week,		389	413	33	33	31st week,		390	89	45	1,124
6th week,		416	424	41	30	32d week,		385	103	47	978
7th week,	Feb.	429	481	31	32	33d week,	Aug.	383	111	80	881
8th week,		428	430	42	19	34th week,		444	86	75	776
9th week,		406	443	40	32	35th week,		335	92	87	705
10th week,		479	471	33	34	36th week,		404	151	85	591
11th week,		388	490	42	39	37th week,	Sept.	385	137	116	541
12th week,	March.	479	507	27	41	38th week,		412	177	107	439
13th week,		525	537	33	38	39th week,		380	210	118	351
14th week,		431	465	36	35	40th week,		371	210	125	266
15th week,		461	462	41	45	41st week,		386	228	113	209
16th week,	April.	425	509	36	24	42d week,	Oct.	392	202	107	138
17th week,		426	424	40	35	43d week,		364	212	105	113
18th week,		409	398	28	49	44th week,		364	227	91	107
19th week,		399	409	31	38	45th week,		388	287	65	68
20th week,	May.	431	375	22	33	46th week,	Nov.	402	299	78	54
21st week,		398	317	36	40	47th week,		365	282	65	46
22d week,		383	323	26	41	48th week,		374	322	65	48
23d week,		454	235	29	58	49th week,		373	318	58	38
24th week,	June.	412	220	22	56	50th week,	Dec.	401	339	58	33
25th week,		381	194	26	78	51st week,		385	337	50	25
26th week,		353	146	26	136	52d week,		390	377	65	40

Scarlet-Fever.

The total number of deaths from scarlet-fever reported in 1888 was 260, and the average weekly mortality from the same cause was 5. The average weekly mortality of reported cases from the same disease in each month was as follows: —

January,	17	July,	1
February,	10	August,	1
March,	10	September,	2
April,	6	October,	2
May,	4	November,	2
June,	3	December,	2

The months having the greatest reported mortality from this cause were January, February and March; and those having the least were July and August.


MEASLES.
SCARLET FEVER.
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
25
50
75
100
1883 TO 1888 INCLUSIVE.
1888.

The ratio of deaths from this cause to the total mortality was 11.2 per 1,000, as compared with 14.4 per 1,000 in 1887, and 8.7 per 1,000 in 1886. It was also less than that of any year except 1886 for twenty years.

Sixty per cent. of the deaths reported from this cause occurred in the first three months of the year, being apparently the result of the continuation of localized epidemics in the last three months of the previous year.

The summary of the reported deaths from this cause for six years, ending with 1888, comprises the data of 2,008 deaths. From this summary it appears that the least mortality was in the months of July and August, and the greatest occurred in January and December.

Measles.

The whole number of deaths reported as having occurred from this cause in 1888, in the reporting cities and towns, was 65, and the weekly average was 1. The weekly average mortality for each month was as follows: —

January,	1	July,	3
February,	1	August,	1
March,	1	September,	1
April,	1	October,	1
May,	2	November,	2
June,	2	December,	1

The least number of deaths was reported in the month of August, and the greatest number in June and July.

The ratio of reported deaths from this cause to the reported mortality from all causes was 2.8 per 1,000, which was much less than that of 1887, and slightly less than that of 1886.

In the six years' summary, it appears that the greatest mortality from measles occurred in the months of April, May and June, and the least in the months of August, September, October and November.

Diphtheria and Croup.

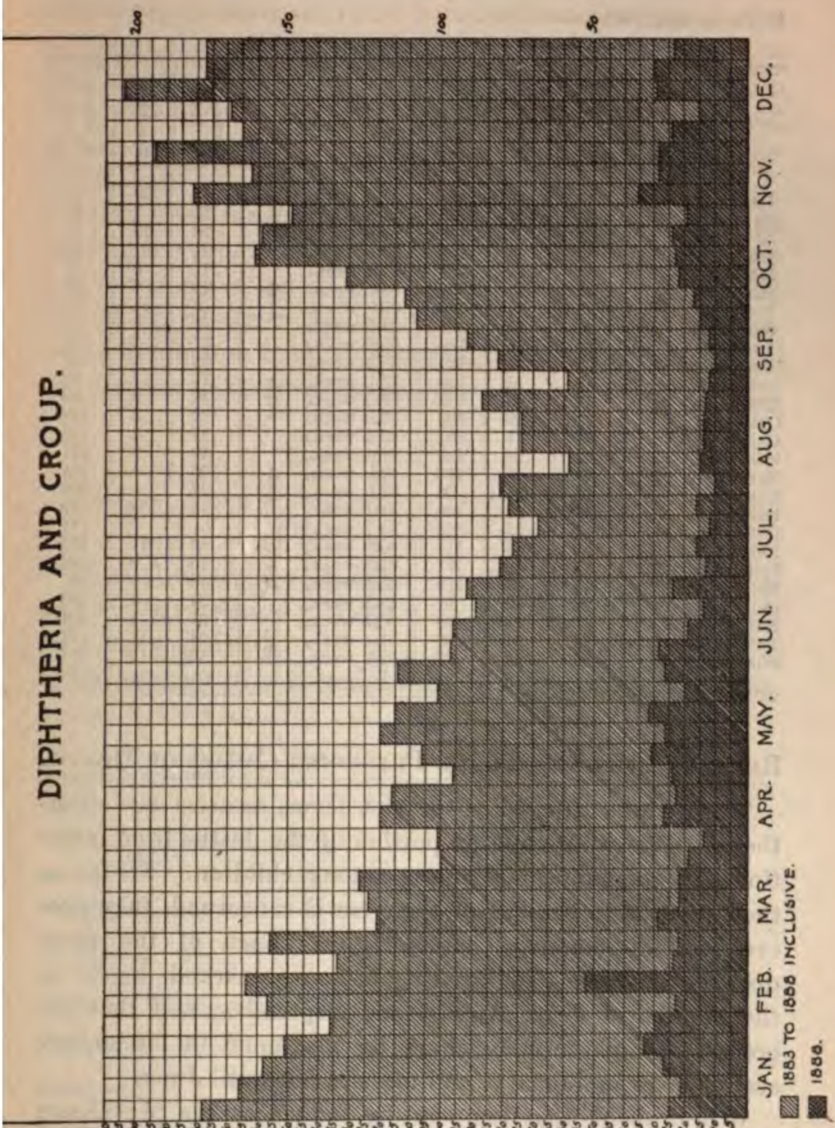
The total number of reported deaths from these causes in 1888 was 1,248, and the average weekly mortality was 24. The average weekly mortality reported for each month was as follows: —

January,	27	July,	14
February,	32	August,	13
March,	25	September,	12
April,	22	October,	21
May,	27	November,	27
June,	24	December,	44

The months in which the least mortality was reported from these causes were July, August and September; and those in which the greatest mortality was reported were December and February.

The ratio of the reported mortality from this cause to the reported mortality from all causes was 53.6 per 1,000, which was greater than that of either of the three preceding years, — 1885, 1886 and 1887.

The summary of reported deaths from these causes for the six years ending in 1888 comprises the data of 6,496 deaths. The least mortality from these causes for the six years occurred in July, August and September, and the greatest in the months of January, November and December.


DIPHTHERIA AND CROUP.
200
150
100
50
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
1883 TO 1888 INCLUSIVE.
1888.

The reported deaths for each week for the six years 1883–1888, from scarlet fever, measles, and diphtheria and croup, were as follows: —

Weeks.		Scarlet-Fever.	Measles.	Diphtheria and Croup.	Weeks.		Scarlet-Fever.	Measles.	Diphtheria and Croup.
1st week,	Jan.	49	13	178	27th week,	July.	17	28	81
2d week,		65	15	166	28th week,		25	7	77
3d week,		53	5	158	29th week,		20	13	68
4th week,		50	8	151	30th week,		21	21	78
5th week,	Feb.	50	18	136	31st week,	Aug.	17	5	81
6th week,		43	15	157	32d week,		24	9	58
7th week,		45	11	164	33d week,		18	11	74
8th week,		27	15	134	34th week,		23	5	74
9th week,	March.	40	15	156	35th week,	Sept.	27	5	87
10th week,		59	11	121	36th week,		32	2	59
11th week,		48	15	124	37th week,		27	3	82
12th week,		44	26	127	38th week,		32	5	92
13th week,		40	18	100	39th week,		32	3	108
14th week,	April.	52	15	101	40th week,	Oct.	27	4	112
15th week,		43	26	120	41st week,		40	5	131
16th week,		45	40	116	42d week,		35	4	161
17th week,		45	24	96	43d week,		37	5	159
18th week,	May.	44	25	106	44th week,	Nov.	41	6	149
19th week,		40	25	120	45th week,		51	3	181
20th week,		45	38	115	46th week,		56	11	162
21st week,		48	42	101	47th week,		45	9	194
22d week,		44	43	114	48th week,		36	5	165
23d week,	June.	26	43	97	49th week,	Dec.	34	9	169
24th week,		35	44	96	50th week,		61	1	204
25th week,		28	31	89	51st week,		63	11	177
26th week,		36	23	92	52d week,		40	13	177

Remarks upon the Three Preceding Causes of Death.

These three diseases, — scarlet fever, measles and diphtheria, — constitute a large portion of the deaths from infectious or communicable causes among children. So far as their relation to seasons of the year is concerned, they present certain common characteristics. Each of the three diseases diminishes in intensity in a very marked degree in the months of July, August and September, and then increases, — diphtheria reaching its maximum in December, scarlet-fever in January, and measles not until June.

It is probable that temperature influences the prevalence of these diseases. The same is also true of small-pox, which, as a rule, prevails with greater intensity in the winter months. Its prevalence, however, in this State in the last decade, has been so slight that no conclusions could be drawn as to the relation of its prevalence to seasons of the year from the

statistics presented. But there is also another condition which undoubtedly influences the prevalence of the three diseases in question, and that is, attendance at school. The period of their least incidence is nearly coincident with the long vacation season of the public schools, when children from different families are separated, and are not subjected to intimate daily contact in closed apartments. Undoubtedly recent laws having reference to the attendance of school-children from infected families, have had a decided effect in limiting the progress of these diseases. This condition must not, however, be regarded as an exclusive one, since, in the case of two of these diseases, — diphtheria and scarlet-fever, — the diminution in prevalence begins at a period considerably anterior to the vacation season.

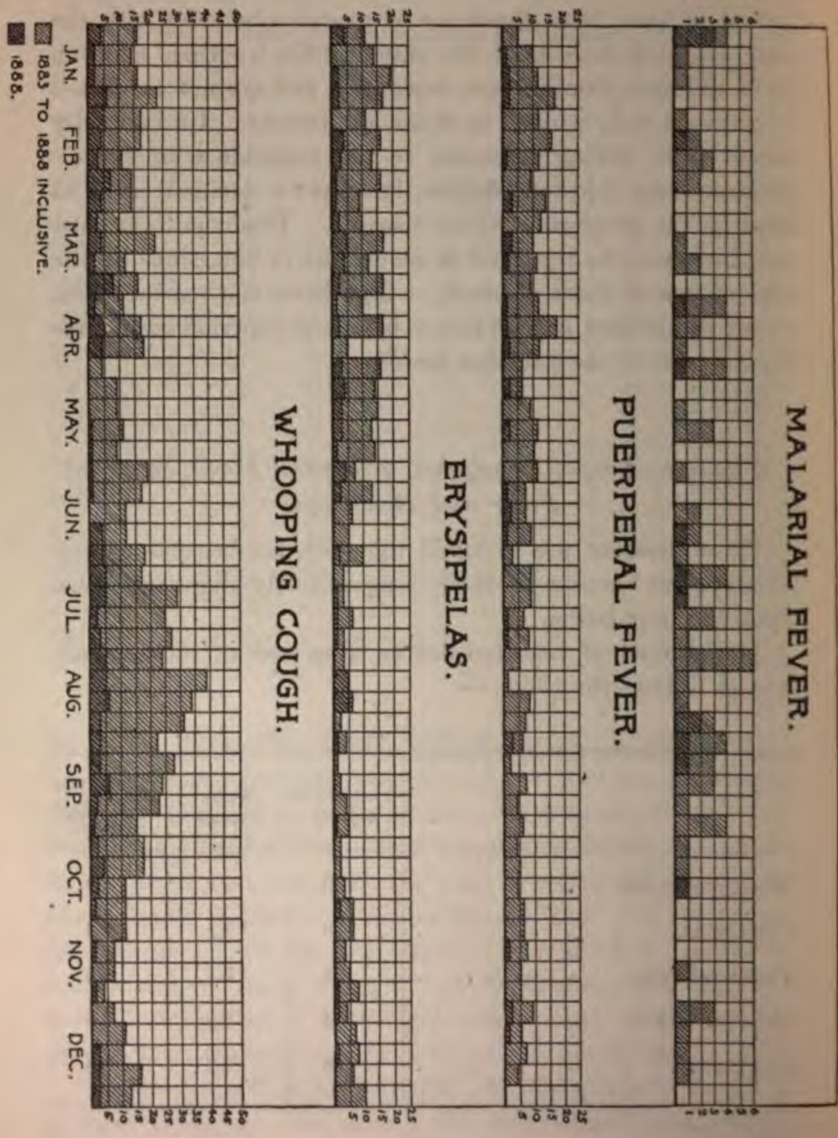
Whooping-cough, Erysipelas, Puerperal Fever, Malarial Fever and Small-pox.

These diseases are grouped together, not because of any affinity, but because of their comparatively slight incidence upon the population.

The number of reported deaths from each of these causes was as follows for 1888 : —

	Total Deaths Reported.	Weekly Average.	Ratio per 1,000 reported deaths from all causes.
Whooping-cough, ...	139	2.7	5 9
Erysipelas, ...	76	1.5	3.3
Puerperal Fever, ...	35	0.7	1.5
Malarial Fever, ...	14	0.3	0.6
Small-pox,.	8	0.2	0.3

The reported mortality from whooping-cough was but little greater than that of either 1886 or 1887. That from erysipelas was greater than that of 1886 or of 1887. That


MALARIAL FEVER.
PUERPERAL FEVER.
ERYSIPELAS.
WHOOPING COUGH.
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.
1883 TO 1888 INCLUSIVE.
1888.

from puerperal fever was less than that of 1886 or 1887, and that from malarial fever was greater than that of either of the two previous years.

Special mention of the cases of small-pox may be found in the general report of the Board.

Definite conclusions can scarcely be drawn, as to the relation of either of these diseases to seasons of the year, from the records of one year; the resulting mean of six years' observations is therefore presented, from which it appears that, —

The mortality from whooping-cough for the six years (1883–1888), as deduced from the statistics of these mortality reports, was greatest in the last half of the year, and in the third quarter, and least in the first half of the year and in the fourth quarter.

The months of greatest fatality were July and August, and those of the least fatality were November and December.

The total number of deaths from this cause, from which these observations were made, was 848.

The mortality from erysipelas for the six years was greatest in the first half of the year and in the first quarter, and least in the last half and in the third quarter. The months of greatest fatality from this cause were January and March, and those of the least fatality were September and October.

The total number of deaths reported from this cause was 444.

The mortality from puerperal fever for the six years was greatest in the first half of the year and in the first quarter, and least in the second half and in the last quarter.

The months having the greatest fatality were February and April, and those having the least were August and October.

The total number of deaths from this cause reported was 416.

The greatest mortality from malarial fever was in the last half of the year in the third quarter, and in the months of September and August, and the least mortality was in the first half of the year and in the fourth quarter, and in the month of November.

The deaths for each week for the six years, from these four causes, were as follows: —

		Whooping-Cough.	Erysipelas.	Puerperal Fever.	Malarial Fever.			Whooping-Cough.	Erysipelas.	Puerperal Fever.	Malarial Fever.
1st week,		16	11	5	4	27th week,		17	3	9	4
2d week,		14	14	10	1	28th week,		9	3	9	1
3d week,	Jan.	16	19	12	1	29th week.	July.	25	6	6	3
4th week,		23	17	17	-	30th week,		27	3	8	1
5th week,		17	11	12	1	31st week,		24	3	5	6
6th week,		17	16	16	2	32d week,		39	5	1	1
7th week,	Feb.	11	13	12	3	33d week,	Aug.	34	6	8	1
8th week,		14	16	9	2	34th week,		31	2	7	3
9th week,		14	9	14	-	35th week,		22	4	6	4
10th week,		10	10	13	-	36th week,		28	1	2	3
11th week,	March.	22	17	10	1	37th week,		24	2	7	3
12th week,		12	12	11	2	38th week,	Sept.	23	4	4	1
13th week,		16	17	9	-	39th week,		15	5	6	4
14th week,		11	10	12	4	40th week,		17	2	4	1
15th week,		17	17	18	2	41st week,		17	2	5	1
16th week,	April.	18	5	12	1	42d week,	Oct.	11	3	4	1
17th week,		4	16	6	4	43d week,		11	6	6	-
18th week,		9	14	6	-	44th week,		11	6	6	-
19th week,		9	15	9	1	45th week,		7	3	7	-
20th week,	May.	11	13	11	3	46th week,	Nov.	7	5	5	1
21st week,		9	14	10	-	47th week,		4	8	5	-
22d week,		19	7	11	1	48th week,		7	4	9	3
23d week,		17	13	7	-	49th week,		11	7	5	1
24th week,	June.	12	6	7	2	50th week,	Dec.	10	8	7	1
25th week,		12	5	9	2	51st week,		16	6	3	1
26th week,		18	10	3	1	52d week,		13	10	1	-

Mortality of Cities.

In the reports of 1885, 1886 and 1887, rates of mortality have been presented for each of the principal cities of the State, for each week in the year. These rates were calculated from the returns sent to the office of the State Board at the close of each week, by the city registrars or other health officials having the registration of vital statistics in charge.

In the census years 1880, 1885, etc., these mortality-rates may be presumed to be quite correct, since they are estimated upon a census of the population. It has been customary to estimate the population of intervening years, from the annual ratio of increase in population from one census year to another. Cities and towns, however, present very different rates of increase at different periods, and while the estimate of the year following a census year may be quite accurate, the estimates made for the second, third and fourth

years will probably be more and more inaccurate in proportion to the number of years which have elapsed since the census.

For this reason the actual number of deaths reported in each week and from each city are given in the following tables, the population stated in each case being that of 1885 (State census).

A few cities have sent no returns, and a few omissions also may be noted in the returns herewith published.

*Mortality of Cities.**

	Boston, 390,393.	Worcester, 68,389.	Lowell, 64,107.		Boston, 390,393.	Worcester, 68,389.	Lowell, 64,107.
Jan. 7, .	232	35	24	July 7, .	164	24	35
14, .	224	26	–	14, .	123	25	44
21, .	267	20	–	21, .	178	29	32
28, .	223	22	29	28, .	240	29	56
Feb. 4, .	209	20	38	Aug. 4, .	244	62	56
11, .	213	26	32	11, .	239	39	38
18, .	206	14	31	18, .	228	37	33
25, .	198	31	26	25, .	202	28	44
March 3, .	207	27	33	Sept. 1, .	217	29	35
10, .	203	26	34	8, .	175	27	39
17, .	223	29	–	15, .	212	37	44
24, .	182	32	42	22, .	205	41	35
31, .	198	24	34	29, .	187	22	27
April 7, .	188	20	28	Oct. 6, .	171	39	36
14, .	222	27	38	13, .	186	27	27
21, .	185	22	39	20, .	188	22	27
28, .	186	18	32	27, .	195	28	39
May 5, .	220	32	34	Nov. 3, .	182	29	39
12, .	195	24	31	10, .	180	22	29
19, .	191	24	24	17, .	166	24	32
26, .	164	24	34	24, .	170	9	26
June 2, .	183	17	21	Dec. 1, .	172	24	21
9, .	180	37	25	8, .	164	17	26
16, .	165	19	26	15, .	170	24	39
23, .	164	24	25	22, .	161	25	34
30, .	183	27	24	29, .	192	23	33

* The populations are those of the State Census of 1885.

Mortality of Cities.

	Cambridge, 59,658.	Fall River, 56,870.	Lynn, 45,867.		Cambridge, 59,658.	Fall River, 56,870.	Lynn, 45,867.
Jan. 7, .	25	20	15	July 7, .	18	37	12
14, .	–	15	18	14, .	22	29	9
21, .	29	36	19	21, .	26	52	19
28, .	28	20	22	28, .	40	56	9
Feb. 4, .	25	26	16	Aug. 4, .	30	41	20
11, .	24	20	12	11, .	21	36	14
18, .	28	28	15	18, .	26	35	23
25, .	29	27	22	25, .	35	36	17
March 3, .	22	33	–	Sept. 1, .	34	35	24
10, .	33	26	20	8, .	34	24	21
17, .	16	36	13	15, .	42	43	17
24, .	20	20	27	22, .	35	30	13
31, .	31	35	18	29, .	30	29	18
April 7, .	24	22	15	Oct. 6, .	31	28	17
14, .	25	34	13	13, .	25	33	15
21, .	33	23	10	20, .	27	22	11
28, .	30	22	24	27, .	24	22	16
May 5, .	21	22	24	Nov. 3, .	21	27	11
12, .	25	23	17	10, .	17	26	15
19, .	20	27	13	17, .	18	23	15
26, .	15	27	21	24, .	17	22	12
June 2, .	19	27	12	Dec. 1, .	22	20	11
9, .	15	25	8	8, .	18	20	10
16, .	19	28	10	15, .	22	22	15
23, .	16	21	10	22, .	25	24	17
30, .	22	35	7	29, .	20	25	15

Mortality of Cities.

	Lawrence, 38,862.	Springfield, 37,575.	New Bedford, 33,393.		Lawrence, 38,862.	Springfield, 37,575.	New Bedford, 33,393.
Jan. 7, .	18	14	11	July 7, .	18	9	10
14, .	19	11	10	14, .	16	22	15
21, .	20	8	14	21, .	26	18	9
28, .	24	19	24	28, .	27	26	18
Feb. 4, .	17	17	8	Aug. 4, .	22	14	15
11, .	25	11	10	11, .	26	20	16
18, .	26	16	12	18, .	20	22	25
25, .	19	18	13	25, .	24	14	14
March 3, .	17	18	13	Sept. 1, .	15	16	22
10, .	23	19	21	8, .	12	10	13
17, .	11	11	9	15, .	13	14	14
24, .	19	17	17	22, .	13	13	23
31, .	19	17	14	29, .	31	8	15
April 7, .	18	22	13	Oct. 6, .	16	11	16
14, .	15	17	25	13, .	22	12	13
21, .	15	17	19	20, .	20	17	18
28, .	10	10	13	27, .	12	16	14
May 5, .	23	13	12	Nov. 3, .	17	12	9
12, .	7	18	4	10, .	8	15	11
19, .	14	17	23	17, .	18	13	11
26, .	11	17	11	24, .	15	10	17
June 2, .	18	8	4	Dec. 1, .	16	17	12
9, .	17	16	14	8, .	8	7	15
16, .	17	14	10	15, .	20	12	6
23, .	10	18	16	22, .	15	10	10
30, .	12	19	15	29, .	22	16	8

Mortality of Cities.

	Chelsea, 25,709.	Haverhill, 21,795.	Taunton, 23,674.		Chelsea, 25,709.	Haverhill, 21,795.	Taunton, 23,674.
Jan. 7, .	14	8	8	July 7, .	8	7	5
14, .	14	16	–	14, .	5	4	6
21, .	13	12	6	21, .	5	8	6
28, .	12	9	11	28, .	8	11	6
Feb. 4, .	21	15	9	Aug. 4, .	9	13	10
11, .	9	10	10	11, .	19	6	10
18, .	14	8	6	18, .	12	11	15
25, .	11	9	8	25, .	12	16	15
March 3, .	13	16	8	Sept. 1, .	16	8	13
10, .	16	12	14	8, .	9	4	6
17, .	14	6	9	15, .	11	10	8
24, .	10	6	11	22, .	9	11	12
31, .	16	7	4	29, .	9	9	7
April 7, .	10	9	14	Oct. 6, .	11	10	9
14, .	12	11	14	13, .	7	9	7
21, .	11	9	5	20, .	10	8	8
28, .	7	15	15	27, .	6	11	5
May 5, .	9	13	6	Nov. 3, .	11	6	6
12, .	9	–	9	10, .	8	6	8
19, .	12	6	9	17, .	11	5	5
26, .	9	8	6	24, .	3	9	7
June 2, .	14	18	6	Dec. 1, .	6	5	5
9, .	11	6	14	8, .	7	8	8
16, .	10	12	7	15, .	8	5	3
23, .	12	10	8	22, .	5	6	6
30, .	5	6	9	29, .	12	11	5

Mortality of Cities.

	Brockton, 20,783.	Gloucester, 21,703.	Newton, 19,759.		Brockton, 20,783.	Gloucester, 21,703.	Newton, 19,759.
Jan. 7, .	6	8	13	July 7, .	1	10	–
14, .	10	3	8	14, .	3	8	3
21, .	5	14	8	21, .	7	6	11
28, .	6	6	–	28, .	5	9	6
Feb. 4, .	–	11	3	Aug. 4, .	5	8	9
11, .	5	5	6	11, .	4	10	7
18, .	6	11	5	18, .	3	19	10
25, .	10	8	11	25, .	10	13	6
March 3, .	6	9	8	Sept. 1, .	6	10	13
10, .	4	4	8	8, .	8	10	5
17, .	11	14	6	15, .	5	7	5
24, .	6	6	5	22, .	11	8	8
31, .	1	14	3	29, .	9	6	4
April 7, .	6	1	6	Oct. 6, .	11	7	6
14, .	7	10	5	13, .	6	5	9
21, .	13	11	9	20, .	6	5	3
28, .	–	6	5	27, .	6	9	6
May 5, .	5	5	7	Nov. 3, .	5	7	9
12, .	5	10	5	10, .	7	8	2
19, .	5	10	6	17, .	5	6	5
26, .	8	10	5	24, .	6	1	6
June 2, .	4	2	7	Dec 1, .	11	4	4
9, .	5	8	5	8, .	2	5	7
16, .	4	6	5	15, .	4	4	3
23, .	6	5	2	22, .	5	5	6
30, .	5	5	5	29, .	8	9	8

Mortality of Cities.

	Malden, 16,407.	Fitchburg, 15,375.	Waltham, 14,609.		Malden, 16,407.	Fitchburg, 15,375.	Waltham, 14,609.
Jan. 7, .	4	9	13	July 7, .	1	1	2
14, .	10	6	3	14, .	4	2	2
21, .	12	9	4	21, .	3	5	5
28, .	5	9	9	28, .	7	9	7
Feb. 4, .	4	5	7	Aug. 4, .	6	10	4
11, .	4	8	3	11, .	7	8	8
18, .	7	7	3	18, .	12	14	6
25, .	5	5	10	25, .	3	11	10
March 3, .	5	4	7	Sept. 1, .	13	13	9
10, .	3	9	2	8, .	9	6	3
17, .	8	8	4	15, .	6	6	2
24, .	8	5	3	22, .	6	6	6
31, .	5	4	5	29, .	8	-	1
April 7, .	4	9	5	Oct. 6, .	5	11	3
14, .	8	4	6	13, .	8	8	7
21, .	10	7	7	20, .	8	13	10
28, .	8	-	3	27, .	4	7	2
May 5, .	6	6	12	Nov. 3, .	7	-	7
12, .	3	-	8	10, .	9	4	4
19, .	8	7	6	17, .	7	8	3
26, .	7	6	1	24, .	10	-	1
June 2, .	11	5	5	Dec. 1, .	5	7	5
9, .	6	5	6	8, .	5	5	6
16, .	7	8	4	15, .	7	5	3
23, .	6	4	4	22, .	5	7	8
30, .	5	11	1	29, .	6	9	5

Mortality of Cities.

		Newbury-port.	Northampton.			Newbury-port.	Northampton.
Jan.	7, . .	8	3	July	7, . .	1	4
	14, . .	6	4		14, . .	4	8
	21, . .	8	7		21, . .	4	5
	28, . .	5	3		28, . .	6	6
Feb.	4, . .	4	3	Aug.	4, . .	9	9
	11, . .	6	3		11, . .	12	6
	18, . .	4	7		18, . .	8	2
	25, . .	8	8		25, . .	7	8
March	3, . .	6	10	Sept.	1, . .	7	6
	10, . .	6	4		8, . .	7	5
	17, . .	6	5		15, . .	3	8
	24, . .	7	3		22, . .	8	4
	31, . .	7	12		29, . .	5	5
April	7, . .	2	7	Oct.	6, . .	5	1
	14, . .	3	2		13, . .	3	5
	21, . .	7	2		20, . .	3	5
	28, . .	7	6		27, . .	5	3
May	5, . .	4	4	Nov.	3, . .	5	7
	12, . .	4	2		10, . .	3	4
	19, . .	5	6		17, . .	3	2
	26, . .	6	7		24, . .	3	5
June	2, . .	7	8	Dec.	1, . .	7	3
	9, . .	6	2		8, . .	5	6
	16, . .	2	2		15, . .	3	3
	23, . .	10	4		22, . .	5	6
	30, . .	4	2		29, . .	7	4

Health of Cities and Towns.

The following summary is compiled from reports forwarded to this Board by boards of health in cities and towns in compliance with a request therefor.

The whole number of such reports received was seventy-two, and this number undoubtedly represents pretty nearly the number of boards which have published reports of their work for the year A considerable number of towns have elected boards of health which have not published a report of their proceedings, while there are also a large number of towns, more than half of the whole number in the State, which have no local board of health other than the board of selectmen.

The urgent need of a better organization of boards of health in towns has already been shown in the general report of the Board.

Prominent among the general subjects which are mentioned in many of the reports of local boards is the necessity of systems of sewerage and sewage-disposal for cities and densely populated towns. The enactment of the statute of 1886 entitled "An Act to protect the purity of inland waters," together with the amendments of 1888 to the same law, has given a decided stimulus toward favorable action in the larger municipalities of the State; and communities are learning, both from their own experience and that of their neighbors, that the rapid removal of household waste and filth from inhabited dwellings is far preferable, especially from the sanitary stand-point, to the storage of such noxious material in the immediate neighborhood of the population, by means of vaults, cesspools and other receptacles.

Infectious diseases have been reported to the local boards of health, as required by the statutes, the compliance with this law having become quite general during recent years, especially in towns where separate boards of health are elected. The law of 1884, requiring a record of all reported cases of contagious disease to be kept, has undoubtedly had a salutary effect, the existence of such a record being a constant reminder of the requirement as to its use by the local board. An occasional case of complaint at court in consequence of violation of the law has served to

remind attending physicians of the importance of prompt compliance with a statute intended for the protection of the whole community.

ADAMS. — Frequent notices of unhealthful places have been received by the board of health, and the nuisances were abated. Faulty house drainage is common. Open cesspools and sewer pipes, sinks without traps, and leaders from piazza roofs entering sewer traps and forming direct ventilation into chamber windows, are of common occurrence.

There have been no epidemics. No case of diphtheria was reported during the year. There were 3 deaths from scarlet-fever, 29 from consumption, 23 from cholera infantum, 8 from spinal meningitis, 7 from pneumonia and 7 from croup; total deaths, 218.

Glanders appeared among horses. Nine were killed, stables were disinfected, suspected animals isolated, and the disease stamped out.

AMESBURY. — The greatest problem of all for the town to solve is how best to dispose of its sewage. The streets of the central part of the town have been surveyed with reference to a general sewer system. A portion has been built, and has thus far proved satisfactory. The board recommends that a portion be built each year, and hopes that sometime in the future the whole will be completed.

Cases of contagious disease reported: scarlet-fever, 15.

AYER. — The following vote was passed at the annual town meeting: —

That the board of health be instructed to report, at the next annual meeting, all action taken by them for the abatement of nuisances, the methods of disinfection prescribed by the board, the cases of contagious diseases reported to the board, the causes of sickness in town during the year, and all regulations of the board affecting the public health.

No interest of the town is more important than the health of its inhabitants. If we could be so insensible as to care nothing for the pains of sickness, or the sorrows caused by death, the health of the town would still be of the greatest importance, from an economic point of view. An unhealthful town is not likely to have a growing prosperity; it will be avoided by those seeking a new home. The loss of time for labor, and the cost of sickness, are taken directly from the resources of the people. The board congratulates the people of the town upon the fact that its previous reputation as a healthy locality has been sustained by a good record for the year 1888.

But one complaint has been made to the board, relative to nuisances, during the year, which appeared to call for official action.

Thirty-three deaths have occurred within the town during the year. Of these, there were from consumption, 3; pneumonia, 2; cholera infantum, 2; cerebro-spinal meningitis, 1; diphtheria, 1. The rate of deaths was 14.83 per thousand inhabitants. For three years last past, 15.72; and for the past seven years, 16.06. Four of these years are based on the population of 1885, — 2,190.

Reports have been made to the board of 10 cases of diphtheria, 13 of scarlet-fever, and 6 of typhoid fever.

The introduction of a supply of pure water for public use is a source of much satisfaction. It has been in use during the year, and there is good reason for believing that it will prove beneficial to the health of the inhabitants of the town.

Attleborough. — A portion of the report is devoted to the subject of the public water supply, and the importance of preventing its pollution.

No epidemic has visited the town. There were a few cases of scarlet-fever and of diphtheria, not fatal. Typhoid fever was present in every month of the year. One case of small-pox occurred in June. The patient was isolated, the community vaccinated, disinfection was practised, and no other cases followed.

The contagious diseases reported were as follows: —

	Cases.	Deaths.
Small-pox,	1	0
Scarlet-fever,	20	2
Diphtheria,	5	0
Typhoid fever,	42	9

Total deaths from all causes, 125.

The cause of the unusual prevalence of typhoid fever is attributed to a general lack of good sanitary conditions.

Belmont. — Cases of contagious diseases reported to the board, —

	Cases.	Deaths.
Scarlet-fever,	35	5
Diphtheria,	21	7
Typhoid fever,	1	1

Total cases, 57.

Bridgewater. — Contagious diseases reported, —

	Cases.
Diphtheria,	6
Scarlet-fever,	0
Typhoid fever,	5

The board emphasizes the importance of pure water supplies, and states several instances of impure well-waters, as shown by analysis of the water. The more general use of the public supply is urged as a sanitary measure. While the dangers arising from impure water supplies are diminishing, those from bad drainage are multiplying with the increased use of town water. A system of drainage will soon be needed.

Fifteen samples of well-water were examined for the board during the year, and in a majority of cases the water was found to be unfit for domestic use.

Boston. — During the year the number of deaths was 10,197, as against 10,073 for the year previous, an increase of 124 deaths, and making a death-rate of 24.57 on an estimated population of 415,000. The increase of deaths is principally in the respiratory class, and more particularly due to pneumonia, which accounts for a greater number of deaths than in any previous year since the Board of Health was organized. The deaths comprehended in the respiratory class alone make 28.9 per cent. of the total mortality.

On the other hand, the deaths from the zymotic diseases show a falling off, and the percentage of deaths of this class to the total mortality is lower than for seventeen years. The deaths from zymotics numbered 1,841, making 18 per cent. of the mortality from all causes.

Another important factor in determining the sanitary condition of the city is the death-rate of children under five years of age, as the weak and the young are the first to be affected by unhealthy surroundings and to become the victims of disease. During the past year 3,598 children died under five years of age, a decrease from 1887, and making the percentage to the total mortality 35.2. This is very favorable when compared with former years, as it is the lowest, with the exception of one year, since 1871.

At the commencement of the year scarlet-fever had obtained a more than usual prevalence, and called for prompt action. The Board found it necessary to make a careful inspection of every case reported, isolating the patients when practicable, and fumigating the premises immediately after death or recovery. The result was a speedy decrease in the number of deaths, so that, from the end of May, the deaths from this cause averaged but about one per month to the end of the year.

Diphtheria was the only preventable disease that assumed an uninterrupted prevalence during the year, and, being of the severest type since 1882, the number of deaths was considerably greater

than last year. Its attack on adult life was greater than for a number of years past, and its suppression in one locality was the signal for a fresh outbreak in another.

The mean temperature for the month of July last was 68.3, the lowest since 1871, with one exception. It will also be observed that there was a marked decrease in the total number of deaths as compared with other years. Taking the deaths from cholera infantum for three months, — June, July and August of the past year, — the percentage to the total mortality was 3.21, the lowest for the same period during seventeen years.

Contagious Diseases.

The number of cases of contagious diseases reported to the Board of Health for the year 1888 was 4,500, against 5,815 in 1887.

The total number of deaths from the same diseases was 734, against 813 in 1887.

Small-pox has been discovered in 8 cases, and there have been 2 deaths, — one in the city and one in quarantine.

In 1887 there were 4 cases and no deaths.

Scarlet-fever was less prevalent.

There were 707 cases reported and 65 deaths, against 1,549 cases and 195 deaths in 1887.

Measles was also less prevalent.

There were 1,517 cases reported and 27 deaths, against 2,227 cases and 119 deaths the year before.

Typhoid Fever was reported in 924 cases, — 67 of which came to the hospitals from other towns, — and there were 170 deaths, against 940 cases and 183 deaths in 1887.

Diphtheria has been endemic in Boston for nearly thirty years. There were 1,411 cases reported and 470 deaths, against 1,049 cases and 316 deaths in 1887. The first death was reported in 1859, and the deaths reported thereafter are given in the following table : —

1859,	19	1869,	61	1879,	391
1860,	1	1870,	51	1880,	588
1861,	17	1871,	39	1881,	601
1862,	46	1872,	28	1882,	458
1863,	108	1873,	59	1883,	445
1864,	118	1874,	72	1884,	345
1865,	51	1875,	420	1885,	334
1866,	52	1876,	577	1886,	329
1867,	47	1877,	364	1887,	316
1868,	67	1878,	448	1888,	470

The distribution of the disease has been quite general throughout the city, but the proportion of cases to population has been greater in the outlying districts than within the older and denser parts of the city. On the annexation of Brighton, Charlestown and West Roxbury, in 1874, it will be seen by the table that the number of deaths immediately increased from 72 to 420.

The deaths from 1870 to 1875 were 249, and from 1875 to 1880, 2,200.

The number of cases of this disease was not known until 1878, when the Board of Health called for the report of cases. The percentage of deaths to the whole number of cases reported each year, for the eleven years, has varied from 26.44 to 35.7.

It will be seen from the table that the disease reached its height in 1881, and then gradually decreased from 601 deaths to 316 in 1887.

"Diphtheria, like small-pox, is a contagious disease, and will spread from person to person and from things which have become infected by the sick person. Being without the advantage of vaccination, as in small-pox, it requires at least thorough isolation, disinfection, and the quarantine of exposed or affected persons; but again, we are without the means for practical isolation or quarantine in cases of diphtheria. Effectual isolation of the sick and infected persons presupposes immediate information of all cases, which we can never get, and a place to put them, which we have not got. Diphtheria, unlike small-pox, is oftentimes difficult to distinguish from several other processes in the throat and nose, may remain unrecognized, or be called by some other name, until the disease has paved the way for many other cases."

Disposal of Wastes.

"The disposition of garbage, ashes, and the miscellaneous mass of débris which is gathered up about the city, is the same as for many years past. The garbage is sold to farmers who come for it and use it in feeding swine in the suburbs of the city. Some of the ashes and street-sweepings are used in raising streets and low lands, and the remainder, which is of a miscellaneous character, is taken by the dumping-boat to a distance of ten miles in the harbor.

"We have witnessed the operation of several crematories for this material in other cities, but the cost attending the process is such as to be a serious hindrance to its general adoption.

"A new process has recently been put in operation in Buffalo, N. Y., called the 'Merz Extractor,' by which garbage alone is treated. This process extracts or separates the water, oil, and

ammonia, and leaves an inoffensive powder. The oil and ammonia being separated have a commercial value, and aid in paying the cost of the process. The difference between this latter process and our present method of treatment of garbage would involve an additional annual expenditure of about $80,000."

House-to-House Inspection.

The house-to-house inspection of blocks selected in different parts of the city, including some of the newest and best dwellings as well as some of the poorest, has been continued as usual, and with the result of finding very many bad conditions where they were not expected by the board of health, or suspected by the occupants of the houses.

The number of nuisances abated during the year was 8,864, of which number 2,479 related to defective house-drains, 1,419 to privy-vaults (full or defective), 1,163 to water-closets, 883 to filthy cellars, and 651 to deficiency of traps.

The number of places disinfected was 84,077. In the performance of this work the following disinfectants were used: Bichloride of mercury, 1,890 pounds; chloride of lime, about 78,000 pounds; and 10 barrels of copperas, besides other disinfectants in lesser quantities.

The following table shows the number of houses disinfected, following contagious diseases: —

Scarlet-fever,	509	Small-pox,	18
Diphtheria,	918	Membraneous croup,	4
Typhoid fever,	6	School-houses,	6
Typhus fever,	1	Infected bedding, clothing, etc., lots,	11
Measles,	3		
Tonsillitis,	1		
Gastric fever,	1	Total,	1,479
Puerperal fever,	1	Number of rooms disinfected,	3,527

Vaults removed or abolished under the provisions of "An Act in relation to the Preservation of Health in Buildings in the City of Boston," 760. Total in four years, 4,155.

Sixteen complaints were entered for violation of health laws, with convictions in all except one.

Brockton. — The total number of deaths in the city during the past year was 362, which, calculated on a basis of 25,000 inhabitants, gives a death rate of 14.48 to each 1,000 of the population, nearly 1 per cent. less than the death rate of last year.

Contagious diseases reported: diphtheria, 24; scarlet-fever, 24; scarlatina, 14; measles, 7, — total, 69.

"That the city of Brockton is not any nearer a practical solution of the sewerage problem than when the question first began to be agitated is a well-known fact, and in a city that is growing as fast as this, the question is becoming one of vital importance.

"Admitting that we can take care of the sewage for a few years, in the manner we are taking care of it now, the fact still remains that we must adopt some system, and that, when we have decided upon a plan, it will take time to put in operation."

BROOKLINE. — There have been reported during the year ending Dec. 31, 1888, 21 cases of scarlet-fever, 7 of diphtheria, and 9 of typhoid fever.

The following table shows the number of cases of scarlet-fever and diphtheria reported during the last twelve years, and the number of typhoid fever cases during the last seven: —

	Scarlet-fever.	Diphtheria.	Typhoid Fever.
1877,	46	29	–
1878,	15	19	–
1879,	16	12	–
1880,	17	25	–
1881,	5	26	–
1882,	12	7	4
1883,	24	7	23
1884,	38	19	12
1885,	40	3	9
1886,	79	9	13
1887,	27	1	9
1888,	21	7	9

The whole number of deaths within the town was only 123, against 154 in 1887, 149 in 1886, and 145 in 1885, or a mortality of 11.43 per 1,000, the estimated population being 10,328.

There were 3 deaths from diphtheria, 5 from scarlet-fever, and 2 from typhoid fever.

"An inspector, who is able to devote much of his time to the matter, should be employed, as there is much work that ought to be done, especially in looking after the condition of the tenement houses. Nothing less than a house-to-house inspection should be made once a year. It is much easier to prevent an epidemic than to put a stop to it when it once has a foothold."

Twenty-six notices have been served for the abatement of nuisances, and there have been two prosecutions for non-compliance with the orders of the board.

CAMBRIDGE. — "The plan of a metropolitan system of drainage, providing for the sewage that is now poured into Charles River and Alewife Brook, if adopted, will be the most important matter that has ever been presented to the city government, both from a sanitary stand-point and as a matter of cost, and every member of the city council, as well as our citizens generally, should take especial pains to inform themselves as to its details.

"The new water supply from Stony Brook has been abundant during the whole of the year, and, we believe, of as good quality as could be obtained in this vicinity; so far as we know, it has given general satisfaction to our citizens; but the city council should not lose sight of the fact that the streams supplying this water run through a farming district, and one too in which the population is constantly increasing, and that they cannot be assured that the water is not being contaminated, except by the most careful policing at short intervals.

"Through the energetic management of the water board the sanitary condition of the shores and surroundings of Fresh Pond have continued to improve as in former years; but, in defiance of all their efforts as well as those of this Board, there is one standing menace to the comfort of the people living in this vicinity, as well as those who visit the driveway around the pond, if not to the purity of the water of the pond itself, and that is the hog-slaughtering establishments near Concord Avenue."

During the year the health officer has visited and examined the school-houses, more particularly in relation to their ventilation. Many of these houses have small and poorly arranged ventilators; in some of them neither the teachers nor the janitors knew how to operate them, and some of them did not even know what they were for.

The whole number of deaths is 1,390, 65 more than last year. This increase is fully accounted for by the increase in population. The number of cases of contagious diseases is the same as last year, 536. One hundred and sixty-five of these were cases of typhoid fever, 40 more than last year. This increase in the number of cases of this disease was not alone in Cambridge, but was general throughout New England.

Analysis of Sewage from Bridge Street Sewer, etc., 1888. Parts in 100,000.

Date.	Where Collected.	Total Solids.	Residue.	Loss on Ignition.	Free Ammonia.	Alb. Ammonia.	Total Ammonia.	Remarks.
SAMPLE No. 1.								
July 31, .	Taken from first man-hole from corner Bridge and Fourth Streets, going toward Somerville. (Samples taken from this man-hole last year marked No. 3.)	496.00	194.00	302.00	13.20	26.20	39.40	After keeping one week, Free Ammonia, . . 033.60 Alb. Ammonia, . . 007.90 Total, ... 041.50 These samples were taken at low tide.
Aug. 16, .		372.00	228.00	144.00	5.90	10.80	16.70	
Oct. 16, .		352.00	196.00	156.00	3.80	7.30	11.10	
Oct. 31, .		142.00	62.00	80.00	5.10	4.60	9.70	
Nov. 12, .		308.00	178.00	130.00	3.20	4.40	7.60	
SAMPLE No. 2.								
July 31, .	Taken from second man-hole from corner Bridge and Fourth Streets, and just below where Messrs. Squire & Co.'s new drain enters the sewer. (Samples taken from this man-hole last year marked No. 3x.)	240.00	68.00	172.00	9.60	10.30	19.90	Samples taken at low tide.
Aug. 16, .		324.00	202.00	122.00	8.60	9.60	18.20	
Oct. 16, .		204.00	118.00	86.00	3.80	4.80	8.60	
Oct. 31, .		218.00	102.00	116.00	6.80	7.80	14.60	
Nov. 12, .		168.00	92.00	76.00	2.50	4.10	6.60	
SAMPLE No. 3.								
July 31, .	Taken from third man-hole from corner Bridge and Fourth Streets, close to railroad crossing (above). Above Squire's drain, and just below where North & Co.'s drain enters the sewer.	248.00	108.00	140.00	14.20	11.60	25.80	No samples were collected from this man-hole last year. Samples taken at low tide.
Aug. 16, .		152.00	66.00	86.00	3.60	2.20	5.80	
Oct. 16, .		172.00	128.00	44.00	2.30	1.80	4.10	
Oct. 31, .		234.00	126.00	108.00	7.80	6.20	14.00	
Nov. 12, .		142.00	74.00	68.00	33.10	3.30	6.40	
SAMPLE No. 4.								
July 31, .	Taken from fourth man-hole from corner Bridge and Fourth Streets, above where North & Co.'s drain enters the sewer.	106.00	38.00	68.00	6.30	1.80	8.10	Samples taken at low tide.
Aug. 16, .		88.00	38.00	50.00	3.20	2.10	5.30	
Oct. 16, .		52.00	18.00	34.00	1.60	1.30	2.90	
Oct. 31, .		124.00	58.00	56.00	6.40	3.70	10.10	
Nov. 12, .		88.00	32.00	56.00	2.10	1.80	3.90	
SAMPLE No. 5.								
July 31, .	Taken from three man-holes side of North & Co.'s establishment.	312.00	126.00	186.00	25.20	8.20	33.40	No thick deposits of grease found in man-holes this year.
Aug. 16, .		282.00	112.00	170.00	17.60	4.60	22.20	
Oct. 16, .		2032.00	1778.00	254.00	6.80	10.80	17.60	
Oct. 31, .		558.00	334.00	224.00	16.40	10.40	26.80	
Nov. 12, .	(The first three.)	1132.00	482.00	650.00	33.20	51.60	84.80	
SAMPLE No. 6.								
July 31, .	Taken from man-hole in Squire & Co.'s yard, back of hog house.	1032.00	512.00	520.00	44.80	17.60	62.40	Bloody and offensive.
Aug. 16, .		372.00	242.00	130.00	23.20	7.40	30.60	These samples not so bloody as others.
Oct. 16, .		684.00	488.00	196.00	11.60	10.40	22.00	
Oct. 31, .		1192.00	538.00	654.00	16.40	22.40	38.80	
Nov. 12, .	New drain.	1378.00	386.00	992.00	29.20	76.80	106.00	Very bloody and offensive.

CHATHAM. — In the month of February, 1888, scarlet-fever became epidemic, more particularly in West Chatham. This epidemic was caused by the introduction of a case from a neighboring town. In this family were several children, all of whom, one after the other, came down with the disease. It then broke out in five other families, making in all about 21 cases, of which one proved fatal. It is difficult for some to realize that a mild and easy case of scarlet-fever or diphtheria is capable of communicating the disease in its worst and most fatal form. An acknowledgment of this well-established medical fact would have rendered the agent's duties much easier. Perfect isolation of infected families was enjoined, and the schools in West and North Chatham were for a time closed as an additional safeguard against the extension of the disease. During the prevalence of this disorder, diphtheria appeared in several families in South Chatham, two of which proved fatal. After the epidemic had subsided, thorough disinfection of the houses was advised and thoroughly enforced. The usual plan was to visit every family where there was any rumor of disease among children in which no physician was employed; in this way none escaped the precautions necessary to be taken. When the disease was fully developed and unmistakable, the house was quarantined and perfect non-intercourse enjoined; by this means the community was protected; thorough disinfection was employed in the house during the existence of the disease, and, after recovery, a thorough fumigating by sulphurous acid vapor was enjoined and enforced. In some cases, as also in diphtheria, the houses in which it existed were repapered and repainted inside, these precautions not seeming unnecessary under the peculiar circumstances.

CHELSEA. — The whole number of deaths for the year is 619, an increase of 56 over last year. The number of deaths from consumption is 87, an increase of 20 over that of the previous year.

The actual death rate of the city for the year 1888 is about 18 for each 1,000 of the population.

Contagious diseases reported: Diphtheria, 40; scarlet-fever, 177; typhoid fever, 29.

CHICOPEE. — The sanitary condition of the town during the year last past has, to say the least, been as good as in any recent year. As usual, the services of the board of health have most frequently been required in cases where heaps of swill and garbage have been allowed to accumulate and remain in the yards in the rear of

dwelling-houses. This source of disease could be most effectually dealt with by the employment of public scavengers for the removal of house-offal, as is done in most towns of equal size elsewhere. No epidemic form of disease has occurred in town during the year, and it is hoped that, after the sewer systems of both villages shall have been completed as proposed, thus securing a thorough draining of the subsoil in all the thickly settled localities, the prevalence of malarial diseases will be greatly diminished.

Last July, a man previously infected with small-pox removed from Adams to this town and entered one of the large boarding-houses. As soon as the disease manifested itself sufficiently for recognition, the patient was removed, together with his personal effects and the other members of his family, to the pest-house. And, though one of the family afterwards died, the disease was confined to its original source and did not obtain further foothold in the town.

The duties of boards of health in towns have been recently increased by statute and now include supervision of cases of contagious disease among domestic animals. Hog cholera has been found in several instances; but little loss has occurred, and this disease has been less prevalent than during the past few years.

Two hundred and seventy-nine deaths occurred in the town during 1888; or, a ratio of 23.25 persons in 1,000, based upon a population of 12,000. Deaths from zymotic diseases were 63; consumption, 38; pneumonia, 18; cholera infantum, 18; typhoid fever, 8; diarrhœa, 8; diphtheria, 7; croup, 6; typho-malarial fever, 3; dysentery, 3; cerebro-spinal meningitis, 3; scarlatina, 1; small-pox, 1; mumps, 1.

Concord. — The agent of the Board has made three regular inspections through the more thickly settled parts of the town, comprising the houses and premises of four hundred and sixty-six tenements, finding the following sanitary defects: —

Waste pipes needing traps,	136
Traps in waste pipes defective,	119
Cesspools found to be defective,	167
Wells unfit for use,	4
Pig-pens found to be defective,	6
Privy vaults found to be defective,	90
Drains found to be defective,	16

Notices have been sent to the owners or agents of the premises inspected in two hundred and fifty-six cases. The requirements

of the Board have been complied with, as found upon the last inspection, in the majority of cases.

Cases of contagious diseases reported to the Board of Health: Scarlet-fever, 3; diphtheria, 8; typhoid fever, 16.

The diphtheria in two cases was considered to be the result of an overcrowded house, with the attendant excess of sewage.

Five of the cases of typhoid fever had a traceable origin outside of Concord, five were considered to be the result of defective sanitary surroundings, and in the other six cases the origin was not found.

" To obtain a better idea of the condition of the water of some of the wells in use in Concord, we sent three samples to Dr. E. S. Wood, Professor of Chemistry at the Harvard Medical School. As it may be of interest to the town we insert the analyses: —

Figures express parts per 100,000 of water.

	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Residue.			Hardness.
				Fixed.	Volatile.	Total.	
No. 1, .	0.0032	0.0900	8.45	19.90	9.10	29.00	8°

" Transparency, clear.
" Color, none.
" Odor, none.
" Characteristics on ignition, considerable blackening.
" Nitrates. Trace by ferrous sulphate test.

" REMARKS. — A very suspicious water; the excessive amount of albuminoid ammonia, chlorine and residue, the high degree of hardness, and the trace of nitrates give rise to a very strong suspicion of contamination by injurious organic matter, and the water cannot be recommended for household use.

	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Residue.			Hardness.
				Fixed.	Volatile.	Total.	
No. 2, .	0.0180	0.0880	6.40	23.80	9.30	33.10	8½°

" Transparency, fairly clear.
" Color, very slight.
" Odor, foul.

"Characteristics on ignition, much blackening.

"Nitrates. Trace by ferrous sulphate test.

"REMARKS. — This water is highly contaminated, and is unfit for household use.

	Free Ammonia.	Albuminoid Ammonia.	Chlorine.	Residue.			Hardness.
				Fixed.	Volatile.	Total.	
No. 3, .	0.0164	0.1960	9.40	26.70	24.10	50.80	8°

"REMARKS. — This water is highly contaminated, and unfit for drinking or other domestic purposes."

COTTAGE CITY. — "We are pleased to report the sanitary condition of the town the past season as having been excellent, and we have received but two notices during the year of diseases of a contagious nature.

"We feel called upon to renew our recommendation for constructing more tight vaults and cesspools, believing the public health demands it. Much, however, depends upon each individual to see that their premises are kept at all times free from odors."

DEDHAM. — The year 1888 has been wholly free from epidemics of any kind. Only one death from typhoid fever and three cases of diphtheria have been reported.

"The pollution of our water-courses and streams tributary to Charles River is a matter that should be well kept in mind. The law is very explicit in this matter. The citizens should remember not to commit their refuse matter, of whatever kind, into these natural streams, and then petition the Board of Health to clear said stream at the expense of the town.

"In 1887 private individuals, in great part at their own expense, and in small part aided by the town, under the direction of the Board of Health, commenced a system of drainage of the meadows within the immediate vicinity of Dedham village. These meadows, as everybody knows, constitute an extensive morass of many acres, which have of late years been an increasing blight upon and a hindrance to the growth and development of the town. It is a continual menace and a source of anxiety that never diminishes. It is capable of demonstration that a large proportion of cases, of whatever disease, that in number have approached an epidemic

since the organization of the town, nearly all the fatal cases have been in families living in close contiguity to the widely extended acreage of meadows."

DUXBURY. — "Now that the manufacture of fertilizer is no longer carried on in the works at Captain's Hill, there is no matter which can be expected to call for special or continued attention, and certainly all other cases coming under the jurisdiction of the Board of Health can be considered and acted upon more economically and efficiently by the selectmen, acting as such a Board."

Last spring there was one case of diphtheria in the west part of the town, and, during the summer and fall, numerous cases of whooping-cough and scarlet-fever interfered with school attendance in one district, but happily they were confined to narrow limits. In accordance with the law of 1884, reports and records of the cases of diphtheria and scarlet-fever have been made.

EASTHAMPTON. — There were five cases of contagious diseases during the year previous to the first of January, and ten cases since, all of which have been reported to the school committee according to the provision of the statute. There has been quite a number of cases of scarlet-fever in Nashawannuck village, which greatly reduced the attendance in the public schools.

EVERETT. — The Board has made strenuous efforts to prevent the spread of contagious diseases by means of disinfectants, fumigation and the enforcement of sanitary regulations. It is believed that much has been accomplished in this direction, although many difficulties have been encountered on account of there being no system of sewerage.

The Regulations of the Board were distributed early in the year to every house in town. That this aroused people to the importance of complying with said Regulations is shown by the increased number of complaints to the Board concerning violations of the same. Four hundred and twenty complaints have received the attention of the Board during the past nine and one-half months, and proper action taken thereon. Fifteen prosecutions have been instituted against violators of the Regulations.

The Board decided, after consultation with many citizens, to put on an offal wagon and make regular collections of swill. The urgent need of doing so was at once shown, as from eight to twelve loads per week were gathered for some time. Some of the

offal first collected was in such condition that it is surprising it did not create a pestilence in the localities where it had evidently been accumulating.

After some weeks, finding the expense could be lessened thereby, the collection of swill was let out by contract to the lowest bidder, after duly advertising for proposals, until the first of April, 1889.

Sewerage. — The importance of establishing a system of sewerage as soon as practicable cannot be too forcibly emphasized. We believe the majority of them are becoming aware of its necessity. The appointment of a drainage committee is a step in the right direction, and we hope they will soon be able to propose something practicable.

"As we understand it, the problem seems to be: What plan shall be adopted? Two are being considered.

"First, An independent town system which shall empty at some point into Mystic River.

"Second, The great Mystic Valley system as proposed by the State Board of Health."

The former, if it can be carried into effect, would doubtless be the less expensive, and, if at once undertaken, afford more immediate relief than the latter. If the former system is not or cannot be introduced, the latter probably will be by legislative enactment. Whatever the cost, if either plan, it will be money well expended.

Contagious Diseases. — There has been a less number of cases of typhoid fever, scarlet-fever and measles reported than during the previous year, but there has been a far greater amount of diphtheria, which has prevailed more or less a large part of the year. At one time during the summer it threatened to become epidemic and assume a virulent type, but stringent measures were taken to abate the disease, which fortunately proved successful. There has been a greater number of deaths from contagious diseases, and also from general diseases, than in 1887, which is partly accounted for by increased population.

The Board has during the past year adopted the custom of putting up cards on houses infected with scarlet-fever and diphtheria, as is done in other places, that people might be duly warned thereby.

It has also been customary for the Board to make a personal inspection of premises wherein occurred any contagious disease. In the majority of instances defective sanitary conditions have been discovered and rectified. This fact has been particularly noticeable where deaths have occurred.

Fall River. — Free vaccination has been provided for all who were unable to pay for the same. Two hundred and fifty-two persons were vaccinated. Fresh vaccine has been kept constantly on hand at the dispensary.

During the year 265 notices have been served for parties to abate nuisances. Three hundred and eighty-one nuisance cases were abated without the serving of notice. Ten notices have been served requesting parties to enter the public sewer, and in all cases the request has been complied with.

Cases of contagious diseases reported: Diphtheria, 46; scarlet-fever, 253; typhoid fever, 202; measles, 65; total, 566. Deaths: Diphtheria, 17; scarlet-fever, 56; typhoid fever, 43; measles, 11; total, 127.

Phthisis pulmonalis [consumption] holds the first rank as the chief destructive disease, 204 deaths having occurred from it; cholera infantum follows second with 152 cases, of which 64 were in the month of July; pneumonia and congestion of the lungs, 116.

Gloucester. — The number of cases of scarlet-fever returned to the Board during the year was 36; number of deaths, 11, — a very high percentage. The number of cases of diphtheria returned was 25, with only one death.

Typhoid fever assumed quite formidable proportions in a small territory in Ward 2 in the early spring, occasioned, there is reason to believe, by serious pollution of the water used in the neighborhood for domestic purposes. The whole number of cases of typhoid fever returned to the Board during the year was 50, of which number 8 resulted fatally.

In consequence of the prevalence of typhoid fever on Sadler Street and vicinity in March, the Board caused an analysis to be made of the water from a well on the street from which most of the families affected procured their water for cooking and drinking. This water was pronounced "grossly polluted and unfit for use."

The number of nuisances investigated, of which a record was kept last year, was 120, — the number of visits being considerably in excess of that number.

Great Barrington. — The public, it is evident, is beginning to recognize the usefulness of the Board of Health and its ability to prevent and suppress zymotic diseases, and to appreciate its efforts to promote cleanliness and health. Many complaints have been made to the Board, most of which have been satisfactorily adjusted.

The records show that the town has been almost entirely exempt from contagious diseases during the past year, and that the number has been less than usual. There were but 6 cases in all, 2 of which were scarlet-fever and 4 diphtheria, one of the latter proving fatal.

The Board removed from the thickly settled portions of the village all the hog pens during the summer months.

The deaths from infectious diseases were as follows: Typhoid fever, 3; pneumonia, 11; cholera infantum, 8; phthisis pulmonalis, 4; puerperal fever, 1; malarial fever, 2.

Greenfield. — A town of the size and importance of Greenfield should have a board of health other than the selectmen. Upon this board there should be a competent physician, as the prevention of an epidemic of diphtheria, small-pox or other infectious or contagious disease would amply repay any additional expense to the town.

Haverhill. — There have been reported by physicians, during the year, 187 cases of diseases dangerous to public health, against 258 in 1887, 362 in 1886, and 370 in 1885. In February, scarlet-fever of a most severe type broke out in the city and continued to prevail up to the middle of August. Twenty-four cases resulted fatally. At a special meeting of the Board in May, as the number of cases increased and assumed a more violent form, it was thought best for the safety of the public to adopt more active measures to check the spread of the disease. An order was accordingly passed requiring a large warning card to be placed on every house in which existed a case of scarlet-fever or diphtheria, and, as an additional safeguard, the agent was directed to notify the librarian of the public library of all cases reported to the Board.

Among the more prosperous classes, isolation in cases of contagious disease can be carried out, but among the poorer classes no complete isolation can take place until the city provides the necessary hospital accommodations for such cases as may be found impracticable to properly isolate at home. Some parents cannot be persuaded of the necessity of quarantining scarlet-fever patients till after desquamation is completed, and, unless constant watch is kept upon them, children not fully recovered from the disease are allowed to mingle with and expose others to contagion. There is greater need of a hospital for the care and isolation of diphtheria and scarlet-fever than for small-pox, and without such means of isolation the Board of Health cannot justly be held responsible for the spread of these diseases.

While the more central parts of the city are well supplied with sewers, there is an imperative need of sewers in certain newly-built portions of the city. Population has been rapidly extending in certain sections of the city, and entire streets are built up and houses occupied with practically no house-drainage facilities whatever.

HUDSON. — The number of cases of contagious diseases reported to the Board during the year are as follows: Diphtheria, 1; measles, 1; scarlet-fever, 23.

The only disease that has prevailed to any extent during the year has been scarlet-fever, which has spread quite largely through the town, although but few cases have proved fatal.

HYDE PARK. — For the year ending Jan. 31, 1889, there have been reported to the Board the following cases of contagious diseases: —

Diphtheria,	21 cases	with	1 death,	
Scarlet-fever,	36 "	"	1 "	
Typhoid fever,	15 "	"	2 deaths,	
Membraneous croup,	1 case	"	0 "	
Measles,	3 cases	"	0 "	

Against

Diphtheria,	20 cases	with	3 deaths,
Scarlet-fever,	39 "	"	0 "
Typhoid fever,	11 "	"	0 "
Membraneous croup,	2 "	"	2 "
Measles,	5 "	"	0 "

for the year 1887.

The Board has, in compliance with the law, adopted the practice of placarding houses in which there is dangerous contagious disease.

We believe that the keeping of swine in the thickly populated portions of the town should be still further restricted.

The Board has felt obliged to condemn the use for drinking purposes of the water from several wells situated in dangerous proximity to sources of filth, and in a locality where there has been an outbreak of typhoid fever. It advises the discontinuance of the use of well-water for drinking purposes in all thickly populated districts, and in all other places where there is possibility of filth contamination.

The Board, in this connection, wishes in the most earnest manner to urge upon the attention of the people the necessity of an

early and serious consideration of the question of a system of sewerage. They believe it to be of more importance than any other improvement that can be made, inasmuch as the health of the people of the town in a large measure depends upon it.

LAWRENCE. — The following contagious diseases were reported by the physicians during the year: Scarlet-fever, 40; typhoid fever, 208; diphtheria, 27; total, 275. One case of prosecution has occurred during the year on account of negligence in reporting to the Board, and it is thought that there are more cases of contagious diseases than are reported by the physicians.

LEE. — During the year 10 cases of contagious diseases were reported: 6 of scarlet-fever, 2 of diphtheria, and 2 of measles. In each family in which these cases existed the strictest quarantine was insisted upon. In one family, in which were 4 cases of scarlet-fever, the disease was confined to that family.

The Board received during the year forty complaints, principally regarding drainage; these were satisfactorily disposed of.

It is obvious that so long as the present system of drainage and cesspools exists it will be impossible to surmount the present danger to public health. This can only be remedied by some system of general sewerage, which is much needed, and the Board earnestly recommends this to the public for consideration.

LOWELL. — Miscellaneous nuisances abated, 4,931; total, 8,267. The health department has had charge of the collection of ashes and house refuse, in the belief that it could be done far more satisfactorily by the department than if let out by contract. The teams once a week collect all ashes and house dirt that is placed in suitable receptacles upon the edge of the sidewalk. The Board of Health believes that better work can be done by the city than by private parties, in the collection of swill. Many individuals, if permitted to collect swill, will do it at their own convenience, often waiting until the swill is decayed before collection.

When the present Board of Health entered upon its duties, the citizens and public press were agitating the question of preventing the use of swill as a food for cows. Upon looking into the matter the Board found that every man had a perfect right to feed swill to his cows, and no penalty could be inflicted upon him, provided the milk was found, as was often the case, above the standard.

The best remedy for the use of swill as a food is the destruction of all garbage. In some of our seaboard cities this is done by

conveying the garbage some distance down the harbor and dumping into the ocean. In several cities the garbage has been burned in a furnace at a cost of from fifteen to twenty-four cents a ton.

The Board had several of the well-waters used by large numbers of people analyzed, and has found many of them unfit for use. Some of the wells have since been closed up, the water being little else than undiluted sewage as shown by analysis.

A larger number of cases of contagious disease was reported in 1888 than ever before. A strict comparison with the number reported in 1887 would be worthless, for reports were not then required in cases of measles, typhoid fever and membraneous croup, nor was the law lived up to as well in reporting diphtheria and scarlet-fever as at present. The Board announced its intention at the beginning of the year to strictly enforce the law requiring physicians to immediately report to the Board of Health all cases of "small-pox, diphtheria, scarlet-fever or any other disease dangerous to public health." As a rule physicians have cheerfully complied with the law. In all cases where the Board has received knowledge of the existence of an unreported case of contagious disease the attending physician has been asked for an explanation. In no case, as far as is known, has any physician wilfully violated the law.

In many cases of contagious disease the malady can be traced so directly from one family to another that the importance of isolating the first case is evident even to the general public. A physician's neglect to report his cases may cause the loss of human life, possibly the loss of his own children, if an epidemic is started. It is difficult for a busy practitioner to remember every duty, but the duty of reporting his cases of disease "dangerous to public health" is so paramount that the penalty provided for failure to report is none too severe for an omission that may spread an epidemic and result in the loss of many lives. The public has a right to demand that a board of health, regardless of its sympathy for friends and fellow physicians, shall cause every one to be prosecuted who violates this important law.

LYNN. — The Board of Health earnestly urges upon the city government the completion of the outlet sewer in accordance with the original plan. A large body of citizens are seriously impressed by the belief that the present outlet interferes with the comfort, menaces the health, and damages the property of the neighborhood; and it also urges the construction of the western intercepting sewer through the Cottage-street district to the valley of Strawberry Brook at the earliest possible date. Through this

region fine, closely packed sand and clay formations prevail, and in neither of these can cesspools be made operative, except temporarily, and the sanitary condition of the district calls loudly for the extension into it of the sewerage system, through which alone relief can be obtained.

Nine hundred and twenty deaths have taken place in the city the past year, and of this number 73 were from diseases reported to the Board.

Typhoid fever has not been as prevalent during the year as in 1887, either in number of cases or in deaths. Sixty cases and 12 deaths have been recorded in 1888, against 88 cases and 16 deaths in 1887. The disease has been of a comparatively mild type; in only one case have two people in the same house been reported.

Number of cases of scarlet-fever, 108; deaths, 4; an increase over the preceding year of 10 cases, and decrease in deaths of 2. Diphtheria has prevailed extensively the past year, and in two localities became epidemic. Two hundred and forty-three cases have been reported, or have been found by the inspector, including 12 cases of membraneous croup, which was decided by the Board early in the season to be identical with diphtheria. Fifty-four deaths have been reported, 7 of which were membraneous croup, leaving 47 as the number from diphtheria proper. This is a larger number than for any year since 1881. The disease has occurred in all the wards in the city, but in less intensity in wards 1 and 7 than in the others. It has been suggested that the extreme moisture of the year filling the low grounds may have had some effect on the disease, but a careful examination of the localities where the disease occurred shows that the highlands, or those localities where the bed-rock makes its appearance above the soil, suffered quite as much as those on lower ground. Of the 243 cases, 154 had been reported previous to the last day of June; 33 of these cases terminated fatally, and up to this time less than the average rainfall had been noted, the large precipitation of the year being due to the rainfall in the three last months of the year. April 25 a notice was received that a child at No. 53 Nahant Street was ill with diphtheria. The house was at once placarded, and it was found that the premises were fully connected with the sewer and were in good order. A subsequent inspection by two experts failed to show any good reason for suspecting that anything about the premises originated the disease. Two days after a second child was taken ill with the disease, and in rapid succession the grandmother of the children and her sister, the parents of the children, and finally the grandfather, were prostrated with the

disease. The latter and the parents of the children recovered, the rest died. A thorough system of disinfection followed, and the disease was apparently stamped out.

An investigation by friends followed, and it was found that the disease was, in all probability, brought from Boston by a professional nurse who came here as a wet nurse for the child. It was learned that the house where the nurse was procured contained a case of malignant diphtheria at the time.

Malden. — The number of cases of infectious and contagious diseases reported was: Diphtheria, 40; typhoid fever, 23; scarlet-fever, 36; measles, 65. Number of deaths: Diphtheria, 12; typhoid fever, 2; scarlet-fever, 1; measles, 1. Whole number of deaths from all causes for the year 1888 is 369.

"The number of cases of nuisances reported, 115; visited, 115, and abated, 104, — were generally of a character to emphasize the need of a system of sewerage, and the Board feels it their duty to again call your attention to the urgency of some method of disposing of the sewage of the city. With a population of nearly 20,000 people, and a yearly increase of from 1,000 to 2,000, even those not immediately interested in sanitary matters must see the vital necessity of at once adopting some plan for the disposal of the sewage of our growing city.

"After carefully studying the system of sewerage as presented by the State Board of Health, your committee is of the opinion that it is perfectly feasible, and will meet the wants of Malden as well and as cheaply as any system that looks to deep water as an outlet.

"Should this system, or any other of equal merit, be adopted by the Legislature, your committee would recommend that the City Council of 1889 do all in its power to have the work commenced at once, and that our local system be started, and that part of the same in the most populous portions of our city be pushed forward so as to be ready to enter the trunk sewer as soon as completed.

"Should the Legislature fail to adopt the report of the State Board of Health, or some other general system of equal merit, then we believe it the duty of the City Council to petition the Legislature for, and if possible obtain, the right to issue bonds and to construct a local system of sewerage, with the right to empty the same into Malden River near the Everett line, after being treated chemically or otherwise satisfactory to the State Board of Health. And we further believe it the duty of the City Council, through its Committee on Sewerage, to examine into the various methods of treating sewerage, that the best and most economical plan may be adopted."

MARBLEHEAD. — Contagious diseases reported: Diphtheria, 45; died, 16. Scarlet-fever, 23; died, 1. Typhoid fever, 4; died, 0.

"We hope that the extension of the water system during the coming year will be a great help in promoting health, and exempt us from those contagious diseases which are attributed to uncleanliness.

"At the beginning of the year it was found necessary to enforce the law which provides that notices shall be posted on houses where a contagious disease exists. This has been done and proved to be beneficial. These notices ought to be sufficient warning to the neighborhood of its dangerous character. In some localities this does not deter adults and children alike from visiting the house, or from attending funerals without fear of spreading the disease."

MARLBOROUGH. — "We have had great difficulty in keeping some parts of the town in proper sanitary condition, owing to the formation of the soil and the lack of proper and efficient means of disposing of the sewage. We find that in certain localities the matter of disposing of the sewage is comparatively easy, while in others it is extremely difficult. This grows more apparent every year as the population increases in density and our manufacturing interests are extended. We desire to emphasize the necessity of a sewerage system, and we wish to call especial attention to certain localities, the sanitary condition of which is bad and must remain so until more effective methods of disposing of the sewage are provided.

"Our town has a population estimated at about 13,000. Within the limits of the thickly settled portion there are three localities, any one of which is a sufficient source of danger to the health of the people to call for immediate action to provide for the disposal of sewage ——."

Contagious diseases reported to the Board of Health, 53; diphtheria, 19; scarlet-fever, 31; measles, 3. Total deaths, 209; under one year, 55; one and under five years, 31.

MAYNARD. — The Board during the year has abated about thirty nuisances, and many more have been removed without any active intervention from the Board.

"We have had no epidemic or contagious diseases of much importance during the year. Diphtheria, which so ravaged us last year, has been almost unknown, and even contagious sore throats have not been prevalent. Typhoid fever, the exponent of bad water, drainage and decomposition of organic matter, has

been extremely rare. Cholera infantum has not prevailed, except to a limited degree.

"The water supply of the town, as a rule, comes from wells which are largely supplied from surface water, and when we consider that we have the sewage of about 3,000 people to dispose of with scarcely a sewer, the Board hardly feel that they can fully recommend such water for drinking and culinary purposes."

Medford. — Sixteen hundred and ninety nuisances have been investigated during the past year.

Considerable time and labor have been given to the improvement of the sanitary surroundings of the town. Much of this work was necessitated by the almost general neglect of the proper parties in attending to the hygiene of their premises.

This state of affairs was rendered more serious by the very unfavorable weather, a total lack of sewerage, and an imperfect system of drainage. Indeed, the hygiene of the town was in such an unfavorable condition that it caused the Board much anxiety as to the future health of the town.

"The statistics of the town show a marked increase in the number of filth and pulmonary diseases, and the death rate has considerably increased. There is but one remedy for this state of affairs, namely, a system of sewerage and drainage. Till this can be brought about, the people must use the greatest possible care and not neglect the hygiene of their premises in any particular.

"Representatives of this town, with those of other cities and towns interested, were invited to appear at the State House and examine plans of a metropolitan system of sewerage. These plans are without doubt the best that have yet been presented, and it behooves the town to endeavor so far as it can to have them adopted.

"If necessary improvements are made it should be remembered that at no distant day a system of drainage may be introduced, and what money is expended to relieve this nuisance now should be so used as not to be thrown away in the event of the new system of town drainage."

During the past year there has been a large increase in the number of contagious diseases, 206 cases being reported. Of these, 99 were typhoid; 57, scarlet-fever; 24, diphtheria; and 26, measles.

About the first week in July the Board received notification of the existence of several cases of typhoid fever. Several cases were found to be due to impure drinking water taken from the wells. But in almost every case there was found about the prem-

ises of those afflicted, either a foul vault or a filthy and ill-ventilated cesspool. Many cases revealed that the sink drains were not trapped, others that the cesspool and vault have not been cleaned, in some cases for years.

MELROSE. — There have been reported to the Board 66 cases of contagious diseases during the year, classified as follows: Scarlet-fever, 49; typhoid fever, 7; diphtheria, 10.

During the year thirty-seven notices have been issued to owners or agents regarding nuisances existing on or about their premises. These orders from the Board have in all cases received the immediate attention of the parties on whom they were served.

"At the November meeting the Board were directed to examine into and cause to be removed all drains emptying into Ell Pond Brook. Acting under these instructions we made personal inspection of all the territory bordering thereon, also of the brooks and ditches that were tributary thereto. As the result of our investigation, twenty-five notices were served directing the immediate removal of such drains and nuisances there existing. Upon the proper drainage of our town depends largely its future sanitary condition."

MILFORD. — One great nuisance exists, the uncovered and only partially drained outlet of the Main Street sewer. Cases of infectious disease were comparatively few and generally mild. Malarial troubles were numerous in the lower part of the town.

NAHANT. — "But one case of contagious disease was reported to the Board of Health during the year, and that was contracted out of town. The usual care was exercised by the people and the officials to guard against anything that would cause contagion, and to this we ascribe our complete immunity from it."

NANTUCKET. — No cases of contagion have been reported to the Board during the year just ended, and the town is almost free from dangerous nuisances. The village of Siasconset is also in good sanitary condition.

NATICK. — The low rate of mortality from contagious and infectious diseases may be seen, as follows: Diphtheria, 4; scarlet-fever, 5; measles, 1; typhoid fever, 1; total, 11.

In the total of 162 deaths in town last year, the causes which contributed mostly to this mortality were: Consumption, 23; pneumonia, 12; cholera infantum, 4; diarrhœa, 4; dysentery, 2.

The Board was called upon to exercise their duties in the abatement of various nuisances, great and small, 171 times during the year.

NEEDHAM. — The number of contagious diseases reported during the year are as follows: Scarlet-fever, 51; diphtheria, 4; typhoid fever, 1. During the year there has been an increase in the number of cases of scarlet-fever over that of last year, while there has been a decrease in typhoid fever.

Piggeries. The proportions of this industry connected with the farming interests of this town have become so large that it is a question what the result will be; while the farmers thus using city swill have made their farms fertile and green, the crops exceeding anything of former years, yet the matter of health and the depreciation of property in the vicinity of such piggeries raises a doubt in the minds of the inhabitants whether the use of city swill can be tolerated at every place where people choose to use it. It is almost an impossibility for persons to use the article without annoyance to their neighbors and travelling public, as it decomposes rapidly in warm weather and fills the air with obnoxious odors.

"The Board find it impossible to get a majority of the parties to exercise due care and neatness in the use of swill. More care on the part of the users would make it much less obnoxious. The Board have labored earnestly with them from time to time, hoping they would respect their neighbors and the public generally; but their effort has proved almost entirely fruitless, until we feel that some stringent measure must be adopted. We would therefore recommend that the town adopt some rule at its annual meeting regulating the carting and use of city swill.

"Wealth promotes health to a certain degree; health promotes happiness; pure air and pure water promote both. The wealth of a few cannot be allowed to deprive the many of heaven's free gift, that of pure air."

NEW BEDFORD. — In August last complaint was made to the Board that a citizen had put plumbing in a house on First Street, south of Delano, without first filing plans of the plumbing of said house at the office of the Board of Health; also that the plumbing was defective and not in conformity with the regulations.

A suit was brought against this party, and he was arrested on a warrant charging him with violating the rules of the Board of Health, by not filing at the office of the Board of Health plans of the plumbing in the house he was building before beginning the work.

Judgment was rendered in favor of the Board of Health, and the defendant was fined.

The judge stated in giving his decision that he considered the suit a test case as to whether the plumbing regulations [as adopted by the Board of Health] were legal and could be enforced. He said that filing the plans before the work was begun was essential to the enforcement of the rules, as otherwise it would be impossible for the Board of Health to decide whether the work was being done in a proper manner.

Cases of contagious diseases: Diphtheria, 125; scarlatina, 60; typhoid fever, 66. Deaths from contagious diseases: Diphtheria, 37; scarlatina, 6; typhoid fever, 8. The total death rate for 1888 is 21.95 per 1,000 population — 33,393 given at last census. The estimated population being 37,253 [Bureau of Statistics] the death rate will be 19.41 per 1,000.

It is a marked fact that a very large proportion of the cases of zymotic diseases reported to the Board are located in the outlying districts of the city, where the inhabitants are unable to get Acushnet water and have to depend on cesspools and privies to dispose of sewage.

NEWBURYPORT. — During the year the following cases of contagious diseases were reported: Diphtheria, 10; scarlet-fever, 5; measles, 301; typhoid fever, 13.

"The epidemic of measles during summer disclosed a popular error which merits our attention. There is a belief that measles is a trivial disease, needing no restrictions or regulations; and too commonly children are advised to have the disease while young. This false belief is responsible for much sorrowing. The truth is that the disease should be regarded very seriously. It certainly is no advantage to a child to contract it. In the first place the mortality from measles is, beyond all comparison, greatest in the second year of life. In the second place, all educated physicians know that very grave after-effects often follow the disease in children who are not perfectly healthy. Catarrhs of various kinds, deafness, bronchial and lung troubles, so-called scrofulous disorders and other complications often date their origin from an apparently trifling attack of measles, and are frequently the real cause of death later on."

In December, 1888, an unusual number of cases of diphtheria developed among children attending the Hancock Street school, and there naturally arose a suspicion that the first cause was there. The Board was called upon to inspect the premises, which was done, with negative results. Since then, however, more

light has been thrown upon the probable connection of this school with these cases. Two children of one family, attending this school, were sick during the last of November with an affection called by the physician "diphtheritic sore throat." After a few weeks these children returned to school in December, with no precautions to prevent the spread of the disease. There is little reason to doubt that these children, seriously sick with "diphtheritic throats," were the probable cause of the other cases of diphtheria and so-called "membranous croup."

"Too much emphasis cannot be put upon the following statement: Any case of sore throat which is properly called 'diphtheritic' is true diphtheria and should be reported as such to the Board of Health. In other words, there is no such thing as a 'diphtheritic sore throat' except the sore throat of diphtheria.

"To such households as are prevented by poverty and the present exorbitant water rates, we would recommend the collection of rain-water for food and drinking purposes. Sufficient care in the collection and keeping of rain-water makes it a satisfactory supply. If not so palatable as well-water its advantages are far more than balanced by its freedom from the germs of typhoid fever and other diseases which find their way into our wells.

"In our opinion an ordinance prohibiting the use of most wells in the city would not only be justifiable but a desirable measure. One most important need we urge upon the city government. Aqueduct water should be supplied to the public schools of the city for the protection of the health of the children.

"The engineer's plans are for a 'separate system' of sewers, calculated mainly for house drainage. As to the necessity for sewers for this purpose a very short study of the facts will convince everyone. We would urge upon the city government, and upon all citizens, the duty of acting without unnecessary delay to secure the completion of this sorely needed improvement of our city."

North Adams. — "Many nuisances have been abolished. In quite a number of cases householders have been induced to enter the sewers; the collection of garbage by a man in our employ has been continued; the town sewers have been thoroughly ventilated.

"There have been reported to us 114 cases of typhoid fever, 16 of which proved fatal. This is much more than our share of typhoid fever.

"Cholera infantum is another pest with which we are unduly afflicted. We had 34 fatal cases. Deaths from this disease might be diminished somewhat by feeding to infants which have been fed artificially, the milk of a cow that is not turned out to

pasture but is kept in the stable and fed on hay and grain regularly and uniformly. This has been successfully tried by one member of this Board. But, though a good deal can be accomplished by proper food, we think that unhealthy surroundings are the cause of a majority of the cases.

"Estimating our population at 15,000, roughly, our death rate is 19.13 per 1,000.

"We have visited all the principal school-houses in the town, most of them twice. None of those in use have any means of ventilation, except through the doors and windows. The worst case was the Braytonville school-house, which, when we first went there in April, had within it an atmosphere more abominable than the most filthy tenement that it has been our lot to visit during the year. Happily this condition of things has been since largely remedied by the school government, and extensive repairs and improvements have been made. The Academy and the Union school-house have no means of getting any air in or out except through the windows. Also the water-closets are placed in dark cellars, the very places of all others where they ought not to be.

"However large or small, or however well designed, sewers will not run themselves any more than other complicated machines. Last year the Board of Health called attention to this, and recommended that the sewers be frequently 'flushed with water from the town's water mains,' and we are unable to see why so reasonable and needful a matter should not be attended to."

A carefully detailed statement of the reports of contagious diseases is given, including the following items: Date of report, location of each case, name of disease, record of the attendant sanitary conditions. A record of this character may be commended as a model for any town, since it not only serves as a basis for action in future cases, but is also a sanitary educator and leads the community to the exercise of precautious measures in individual cases for the prevention of disease.

"During the year we have caused thirty-three samples of water to be analyzed. In most cases the chemist pronounced the water fairly good, but three wells he pronounced unfit to drink from, and we condemned them."

North Andover. — There has been no unusual amount of sickness in town the past year, excepting measles, which have prevailed to quite an extent at the Centre.

Pittsfield. — A building has been erected on a portion of the town farm for the care of contagious diseases. The building is in

every way adequate for all and any demands to be made, and is in every way, in all that pertains to it, a model building for its purpose.

"We feel called upon to renew our recommendations of last year in relation to the construction of proper sewerage, believing that the public health demands the same. Some form of sewerage for the town must prevail. The western part of the town, as well as the eastern, should have some means afforded them to carry off their waste matter. It is a dire necessity which, in consideration of the rapid growth of this town, must soon be provided for.

"This Board has been called upon in a number of cases to inspect the plumbing in buildings of the town, and has found it necessary to condemn the system in a number of cases. A great amount of plumbing is of galvanized sheet iron. We not only declare this kind of work as being dangerous, but believe some action should be taken so as to allow only pipes of iron to be used. Many escapes or ventilations are made into chimneys. This we believe to be totally wrong and dangerous. All ventilations should be made through the roof."

Since March 20, 1888, there have been made 429 inspections of nuisances.

Contagious diseases reported during the year: Diphtheria, 29; scarlet-fever, 16; measles, 9; whooping-cough, 2; with 7 deaths from diphtheria and 3 from scarlet-fever.

PROVINCETOWN. — "If it were more generally taught, accepted and believed that dirt and filth certainly induce disease and untimely death, healthful cleanliness would prevail; but through ignorance or carelessness, householders allow the insidious untrapped drain or foul privy vault to do its deadly work unmolested."

There have been quite a number of cases of typhoid fever, scarlet-fever, measles, and sore throat, but with no fatal results thus far.

QUINCY. — Over 3,000 inspections were made. Five hundred nuisances were reported (about 300 less than last year), and of these about ninety-six per cent. were abated.

The character of the several nuisances was much the same as given in previous reports, — unclean vaults, cesspools and wet cellars predominating.

"There is still much to be desired in the way of general sanitary improvement, and again we take the opportunity of emphasizing the demand and urgent necessity of a system of sewerage. There exist nuisances difficult or impossible to abate, save temporarily, without such a system."

Of the four piggeries maintained in the town at the beginning of the year, three were discontinued by request of the Board, one requiring legal measures for its abolishment.

In compliance with the statutes requiring the report of all contagious and infectious diseases from householders and physicians, the following have been received: Diphtheria, 82; typhoid fever, 80; scarlet-fever, 31; measles, 32.

ROCKLAND. — "For the year 1888 there were reported 9 cases of scarlet-fever, 12 cases of typhoid fever, 2 cases of diphtheria, and 1 case of dysentery. There were more cases than the above, but through the neglect of the physician and householder they were not reported to us."

SOUTHBRIDGE. — The lack of any system of sewerage, makes it impossible to give the town anything like a proper disposal of sewage. The constant increase in the use of city water renders the present system of cesspools utterly inadequate to provide for the disposal of sewage.

Nuisance Brook still remains the same as the year previous.

The year opened with an alarming increase of scarlet-fever, assuming an epidemic form and continuing through March, April, May, June and July, reaching the extraordinary number of one hundred and twenty cases, twenty-one of which were fatal. The Board found it necessary to make a careful inspection of each case, isolating cases when practicable, fumigating the premises immediately after death or recovery. The result was a speedy decrease in the number of cases, so that at the end of August no cases were reported from that time to the present. Diphtheria has prevailed to no great extent; five cases during the year, one of which was fatal. Cases of this disease, as in scarlet-fever, are immediately isolated and every precaution used to prevent its spread. Three cases of typhoid fever and five cases of measles are reported, none of which were attended with fatal results.

SOMERVILLE. — Number of nuisances abated, 497. Number of tenements ordered vacated, 25.

Inasmuch as the density of the population in many sections of the city required some restriction upon the keeping of cows, regulations were adopted to limit the number. Since the adoption of these regulations several parties who kept large numbers of cows have either gone out of the business or removed elsewhere. One party has been prosecuted for keeping cows without a permit, and conviction secured.

Of the diseases classed by this board as dangerous to public health, scarlet-fever, diphtheria and typhoid fever are the only ones that have visited the city during the year. One hundred and twenty-three cases and 15 deaths from scarlet-fever were reported during the year 1888, of which 88 cases and 13 deaths occurred in the first four months. Diphtheria has increased over the year 1887, but its prevalence has not been greater than in the average of previous years. Seventy-five cases and 21 deaths were reported. Warning cards and fumigation are employed in dealing with this disease, the same as with scarlet-fever, and the sanitary condition of the premises is investigated.

More deaths have occurred from typhoid fever during the past year than in any other of the last ten years, there having been 63 cases and 17 deaths, of which 42 cases and 19 deaths occurred in September, October and November.

Springfield. — Typhoid fever has been somewhat more prevalent than in previous years, although many of the so-called cases are of a typho-malarial character, the outcome of chronic malarial infection. The mortality, however, from both true and malarial typhoid, has been low.

"Diphtheria has increased during the year, especially at its close; and while it would give me great pleasure to accept the published verdict of a 'groundless diphtheria scare,' I confess my inability to so favorably construe the following facts. We have had during the year 189 cases reported, with 65 deaths. Among the many causes assigned to this disease, our sewers have been blamed. In my opinion, they have, certainly at present, little or nothing to do with it. The rain-fall of the past three months has been enormous, millions of gallons of water have been flowing through our sewers, thoroughly flushing and cleansing them from material for the generation of sewer gas. During the summer months, on the other hand, the sewers were unusually foul, and many complaints of foul odors emanating from them were received. Yet December has 37 cases of diphtheria against 15, 19 and 11 in the months of June, July and August, respectively. As stated in my last report, the disease is, I believe, in its inception, atmospheric; its development in this instance favored doubtless by the excessive humidity of the past three months. Once gaining a foothold, however, its continuance and spread is, I believe, chiefly, if not wholly, by virtue of its infectious and contagious character, each case becoming a focus of infection, whence new cases and thus new foci arise. The only preventative, therefore, against the spread of diphtheria in any community where it exists, is the course now adopted by

every organized Board of Health, viz.: notification, isolation, disinfection — the three sheet-anchors against all infectious disease. If every case could at once be known, and isolation and disinfection be carried out to the letter, the disease could, I believe, be effectually held in check and gradually stamped out. For the enforcement of measures to this end, the Board of Health has to rely upon the support and co-operation of physicians and citizens, and it is for this reason that a widespread knowledge of the extent of the disease and appreciation of the magnitude of the danger is of importance against remissness or indifference in such co-operation."

Cases reported: diphtheria, 189; scarlet-fever, 53; small-pox, 4. Deaths: diphtheria, 65; small-pox, 2. Scarlet-fever, as shown in this table, has a record of 53 reported cases without a death.

SWAMPSCOTT. — "During the year we have received and investigated all complaints brought to our notice, and have had official notice of 14 cases of contagious diseases, consisting of 3 of scarlet-fever, 3 of diphtheria, 6 of typhoid fever. Two of scarlet-fever and 2 of typhoid proved fatal."

TAUNTON. — "The need of a system of sewerage has never been felt so urgently, and it is to be hoped that the adoption of some system will be immediate. Our city is increasing in the number of its inhabitants, new houses are being constantly built, and extensions are being made in every direction. Each new inhabitant and each new house is a new and fresh demand for adequate sewage facilities, and longer delay will only make the ultimate expense to the city greater. We would renewedly urge this matter to your special and active attention.

"It is much desired that the inspection of milk be confided authoritatively to the Board. Our milk was formerly quite pure, but late inspection, for the past three years, by the State inspectors, show that adulteration of it is too frequently practised. This mostly takes the form of 'watering' or of altering the relation of the total solids to the mass in some other manner. The number of deaths from cholera infantum (25) during July and August, especially in the eighth ward, compelled the attention of the board. A list of all the cases was made out, and visitation determined the fact that all but three of the deaths were of children bottle-fed. An immediate visit of one of the State inspectors, with sole reference to the examination of the milk delivered in this ward, resulted in the discovery that three separate *milk* men were supplying these babes with watered milk.

Within the year nine milk dealers have been notified of the poor quality of their milk, and seven others just escaped notification, though guilty under a strict construction of the law. It is impossible for the present city inspector to know these facts, or to take action, if action be needed, or to determine if milk be good or otherwise. It is a poor milk dealer who cannot cheat a lactometer. At present, the board of health has no authority in these cases, not even under the general statute, to obtain samples of the milk, or take action against the dealers."

There have been reported to the Board 32 cases of diphtheria, 46 cases of scarlet-fever and 42 cases of typhoid fever. Credit is due to many of the physicians for the promptness of their reports, but great regret is felt that many have not been so careful, and have thereby negatived the efforts of the Board to prevent the spread of some of these diseases.

WARE. — During the year there have been reported to the Board 76 cases of measles, 16 cases of scarlet-fever and 4 cases of diphtheria, this record indicating a marked diminution in the prevalence of diseases of a highly contagious and malignant character from the registration of any of the several preceding years. Measles existed to a greater extent during the early part of the year and was of the usual mild type, no deaths resulting from it when not complicated with some other and more serious affection. Such precautions and measures, however, as were deemed proper and advisable, were taken to prevent its spread, and with the approach of summer it almost entirely disappeared.

The cases of scarlet-fever, typhoid fever and diphtheria were fortunately not very numerous, but were, nevertheless, marked by a high rate of mortality.

The origin of some of the cases of diphtheria could be positively traced to an improperly kept cesspool.

"Our observations for the past year tend to confirm still more deeply our conviction of the pressing need of a properly constructed system of sewers for this town. There is no need of a repetition of our reasons, which have already been given upon this subject. The dangers are still lurking and accumulating, and continue to menace the health and lives of the people. There should be no further delay in this matter, the time is opportune, and we recommend immediate and decisive action. Certainly no citizen with the highest welfare of the community at heart, would obstruct by his vote any measure that would tend to preserve and fortify the good health of the town."

WATERTOWN. — "For the protection of our schools and homes, physicians are required to report to the board of health any disease dangerous to the public health under their care. Such cases are at once reported to the superintendents of schools and also to the public library.

"Much credit is due the local physicians for the prompt manner in which they have complied with the law in this respect. We have had some trouble with physicians from our neighboring cities, but in time we hope they, too, will learn to respect their neighbors."

The number of contagious diseases reported were: Diphtheria, 3; scarlet-fever, 13; typhoid fever, 3; cholera infantum, 10; total, 29. Deaths: Typhoid fever, 2; cholera infantum, 6; diphtheria, 2.

WORCESTER. — Contagious diseases reported in 1888: —

	Number of Cases.	Number of Deaths.	Death Rate, per cent.
Diphtheria,	212	49	23.11
Scarlet-fever,	136	11	8.09
Typhoid fever,	94	23	24.46
Small-pox,	7	1	14.29
Measles (6 months),	318	12	4.09

Complaints for year ending Jan. 30, 1889, 978.

Total number of inspections for year ending Jan. 30, 1889, 1,158.

The various zymotic and contagious diseases have not been alarmingly prevalent, with the exception of measles. In May this was so general that the board thought it advisable to require physicians and householders to report cases, and quarantine infected houses, as far as possible, from the public schools. The idea in so doing was this: that although the cases might be mild, and the disease a comparatively safe one, the schools should not, if possible to prevent it, be the means of spreading any contagious disease.

For the first time since 1880, we have had a serious outbreak of small-pox. In March three cases were discovered and the patients moved to the pest-house. In August the disease again broke out in another part of the city and continued occasionally till October.

Diphtheria and scarlet-fever have increased over the two previous years, while typhoid fever has steadily diminished.

RETURNS

OF

WATER BOARDS AND WATER COMPANIES

OF

MASSACHUSETTS.

8. Whether the watershed is also wholly or in part that of other ponds, streams or reservoirs, besides that used by the party making return; and if so, to what extent.

9. Whether or not the source employed by the party making return is used jointly by some other party for a water source; and if so, by whom.

10. Whether there are other sources within ten miles, not already appropriated by law, that could be availed of in connection with the source or sources now enjoyed by the party making return; and if so, what, and their location, area, watershed, and the means necessary to connect, with the distance from present source, and from territory to be supplied.

11. What danger of contamination the waters at present held are liable to.

12. Whether or not an analysis has been made of the water at present used, and the results of any such; by whom, and where.

13. Whether the waters at present used have been stocked with fish; if so, to what extent, by whom and where.

14. What, up to date, has been the cost of the water works in use, including rights and lands taken, and all damages paid; stating cost of water rights separately, and to whom paid.

15. Whether the storage capacity of the present source can be increased, and at what probable cost, exclusive of damage by flowing, and at what damage to private parties or corporations.

16. Whether any town, village or city discharges its sewers or drains into the source used by the returning party or their tributaries.

17. The population of the town, city or village so discharging its sewers or drains into said source, and the character of its manufactures.

18. The apparent results of such sewage.

19. The average daily consumption for the year of the population supplied by the party making return.

20 The per centum used by families.

21. The average consumption per family, per day.

22. The probable increase of demand, as near as can be estimated, for the next year.

23. The water rates established.

24. The system of distribution, whether by gravity, stand pipe, direct pumping, reservoir or otherwise.

25. The condition of water debt and sinking fund.

26. How the effluent water is now got rid of.

27. Into what stream or body of water it finally flows.

28. What protection against impurity of present source not now provided is desired.

29. What additional expense such protection would involve, and to whom.

At the date of publishing the present report there were in the State the following water works, incorporated water and other companies organized for supplying water for public,

domestic and other general uses: the whole number being one hundred and thirty-two, as compared with ninety such water works and companies in existence at the date of the last report.

List of Water Works and Companies supplying Water.

In Barnstable County:

(*None.*)

In Berkshire County:

(*Fourteen.*)

Adams Fire District.
Great Barrington Water Company.
Berkshire Heights Water Company* (Great Barrington).
Mansfield Lake Water Company (Great Barrington).
Cheshire Water Company.
Dalton Fire District.
Hinsdale Fire District.
Berkshire Water Company (in Lee).
Lenox Water Company.
North Adams Fire District.
Ashley Water Works (Pittsfield).
Richmond Iron Works.
Stockbridge Water Company.
Williamstown Aqueduct Company.

In Bristol County:

(*Seven.*)

Attleborough Water Supply District.
North Attleborough Fire District.
Fall River Water Works.
Mansfield Water Supply District.
New Bedford Water Works.
North Easton Village District.
Taunton Water Works.

In Dukes County:

(*Two.*)

Vineyard Haven Water Company (in Tisbury).
Cottage City has a water supply for fire purposes only.

In Essex County:

(*Twelve.*)

Powow Hill Water Company (Amesbury).
Beverly Water Works.
Danvers Water Works.
Gloucester Water Supply Company.
Haverhill Aqueduct Company.
Lawrence Water Works.
Lynn Water Works.

Essex County — Con.

Marblehead Water Company (in Swampscott — supplies Marblehead, Swampscott and Nahant).
Newburyport Water Company.
Peabody Water Works.
Salem Water Works.
Saugus Water Works.

In Franklin County:

(*Six.*)

Greenfield Fire District.
Covell Aqueduct Company (in Shelburne).
Orange Water Company.
Riverside Water Company (in Gill).
Sunderland Water Company.
Turner's Falls Fire District.

In Hampden County:

(*Eleven.*)

Agawam Water Company.
Chicopee Falls Fire District.
Chicopee Manufacturing Company.
Chicopee Water Company.
Holyoke Water Works.
Crystal Spring Aqueduct Company (Holyoke).
Ludlow Water Works.
Palmer Water Company.
Springfield Water Works.
Westfield Water Works.
West Springfield Aqueduct Company.

In Hampshire County:

(*Four.*)

Amherst Water Company.
Easthampton Water Works.
Northampton Water Works.
South Hadley Falls Fire District.

In Middlesex County:

(*Twenty-Six.*)

Arlington Water Works.
Ayer Water Works.
Belmont Water Works.
Cambridge Water Works.
Concord Water Works.
Everett Water Works.

* Not yet supplying water.

MIDDLESEX COUNTY — Con.

Framingham Water Company.
Hopkinton Water Works.
Hudson Water Works.
Lincoln Water Works.
Lexington Water Company.
Lowell Water Works.
Malden Water Works.
Marlborough Water Works.
Medford Water Works.
Melrose Water Works.
Natick Water Works.
Newton Water Works.
Reading Water Works *
Somerville Water Works.
Wakefield Water Company (supplies Wakefield and Stoneham).
Waltham Water Works.
Watertown Water Supply Company.
Wayland Water Works.
Highland Water Works (Winchester).
Woburn Water Works.

In NANTUCKET COUNTY:

(*One.*)

Wannacomet Water Company.

In NORFOLK COUNTY.

(*Fifteen.*)

Avon Water Works.*
Braintree Water Works.
Brookline Water Works.
Canton Water Works.
Cohasset Water Company.
Dedham Water Company.
Franklin Water Company.
Hyde Park Water Company.
Norwood Water Works.
Quincy Water Company.
Randolph and Holbrook Water Works.
Sharon Water Company.
Stoughton Water Company.
Wellesley Water Works.
Weymouth Water Works.

In PLYMOUTH COUNTY:

(*Eight.*)

Abington and Rockland Water Works.
Bridgewaters Water Company.
Brockton Water Works.
Hingham Water Company.
Kingston Water Works.
Middleborough Fire District.
Plymouth Water Works.
Whitman Water Works.

In SUFFOLK COUNTY:

(*Three.*)

Boston Water Board.
Chelsea Water Works.
Revere Water Company (supplies Revere and Winthrop).

In WORCESTER COUNTY:

(*Twenty-three.*)

Naukeag Water Company (Ashburnham).
Athol Water Company.
Brookfield Water Works.
Clinton Water Works.
Fitchburg Water Works.
Gardner Water Company.
Grafton Water Company.
Lancaster Water Company.
Leicester Fire District.
Leominster Water Works.
Milford Water Company.
Northborough Water Works.
Southbridge Water Supply Company.
Spencer Water Works.
Ware Water Works.
Warren Aqueduct Company.
Slater Woollen Company (in Webster).
West Brookfield Aqueduct Company.
Quaboag Aqueduct Company (West Brookfield).
Cement Aqueduct Company, (West Brookfield).
Westborough Water Works.
Worcester Water Works.
Uxbridge Water Company.

No applications having been received from these parties, as provided for in the statutes, blank forms were issued to all of them in August of the present year (1889), containing the questions required in section 104, chapter 80, Public Statutes. The number of returns received, out of 132 issued to the parties named in the statute, was only forty.

The principal facts required in these returns have already been published twice in the reports of 1882 and 1885, so far as the parties supplying water previous to these dates are

* Not yet supplying water.

concerned; and there is but little additional information in the returns which have been received during the present year which can be regarded as having any actual value, either to the people of the State in general or to the water boards and water companies. The replies made to the questions asked are very imperfect, and, in most instances, no replies are made to a large number of the questions.

If the parties to whom these blanks are sent should answer the questions named in the statute, to the best of their ability, the information would be very fragmentary and unsatisfactory. The Board, therefore, last year advised the repeal of the statutes requiring such returns, and the subject was referred to the next General Court.

Since the date of the last report a very important statute has been enacted (chapter 375 of the Acts of 1888), entitled, "An Act to provide for the protection of the purity of inland waters," which makes the State Board of Health an advisory, and, to a certain extent, a supervisory Board, so far as concerns the public water supplies of the State, since the provisions of the law require that the Board "shall have the general oversight and care of all inland waters." The Board is also required "to cause examinations of the said waters to be made for the purpose of ascertaining whether the same are adapted for use as sources of domestic water supplies, or are in a condition likely to impair the interests of the public or of persons lawfully using the same, or imperil the public health. It shall recommend measures for the prevention of the pollution of such waters," etc. "It shall . . . consult with and advise the authorities of cities and towns, or with corporations, firms or individuals, either already having or intending to introduce systems of water supply, . . . as to the most appropriate source of supply."

In acting under this statute the State Board of Health has found it necessary to make investigations, giving much more reliable and complete information than can be obtained from the answers received in response to the blanks required by section 104 of chapter 80 of the Public Statutes. This material will be published in a supplement to this report, which

is now in press, and will contain all of the information of any value that can be obtained from the replies received in the water-supply returns, except that which relates to the

Name of Water Works Company, etc.	Cost of Works.	Water Rights and Damages.	Water Debt.	Sinking Fund.
Barnstable County. *(No water supplies.)*				
Berkshire County. *Fourteen supplies; three returns.*				
Ashley Water Works, Pittsfield,	$242,504 10	$4,000 00	$182,428 52	-
No. Adams Fire District,	325,000 00	5,000 00	245,000 00	-
Stockbridge Water Company,	18,500 00	-	8,900 00	-
Bristol County. *Seven supplies; four returns.*				
Water Department of Fire District, No. Attleborough,	141,117 55	-	131,000 00	$17,403 67
Mansfield Water Supply District,	71,000 00	-	73,000 00	806 50
New Bedford Water Works,	1,355,320 94	23,739 56	780,000 00	618 79
Taunton Water Works,	558,229 46	-	533,700 00	210,475 39
Dukes County. *Two supplies; one return.*				
Vineyard Haven Water Company,	70,000 00	-	30,000 00	-
Essex County. *Twelve supplies; seven returns.*				
Danvers Water Works,	256,257 29	6,563 02	243,000 00	30,000 00
Haverhill Aqueduct Company,	-	-	-	-
Lawrence Water Works,	1,983,324 53	15,000 00	-	-
Gloucester Water Company,	528,254 45	-	250,000 00	-
Marblehead Water Company,	-	-	-	-
Newburyport Water Company,	349,439 50	5,000 00	-	-
Saugus Water Works,	45,000 00	-	40,000 00	-
Franklin County. *Six supplies; one return.*				
Covell Aqueduct Company, Shelburne Falls,	5,000 00	-	-	-
Hampden County. *Eleven supplies; three returns.*				
Chicopee Water Company,	85,948 66	-	-	-
Holyoke Water Works,	513,663 88	4,844 13	250,000 00	110,072 16
Springfield Water Works,	1,378,357 54	16,000 00	3,000,000 00	-
Hampshire County. *Four supplies; one return.*				
Northampton Water Works,	267,565 07	20,000 00	165,000 00	-
Middlesex County. *Twenty-six supplies; nine returns.*				
Ayer Water Works,	64,000 00	-	-	500 00
Cambridge Water Works,	2,539,780 00	23,468 33	2,439,900 00	716,400 00
Everett Water Works,*	-	-	100,000 00	36,747 06
Framingham Water Company,	225,000 00	-	-	-
Hopkinton Water Works,	35,000 00	-	32,743 83	3,803 80
Lincoln Water Works,	32,000 00	-	30,000 00	7,000 00
Lowell Water Works,	4,453,583 47	50,000 00	-	-
Marlboro' Water Works,	250,000 00	6,100 00	250,000 00	27,788 00
Waltham Water Works,	412,000 00	9,609 50	397,000 00	32,879 77
Nantucket County. *One supply; one return.*				
Wannacomet Water Company,	45,000 00	-	29,852 62	2,000 00

* Supplied by Boston from Mystic Works.

financial condition and water rates. The data received upon these points, at the time of publishing this report, are included in the following table: —

Water Rates.

One Faucet.	Additional Faucet.	Bath Tub.	Additional Tub.	Water Closet.	Additional Water Closet.	Hose.	Stable, one Horse.	Additional Horse.	Boarding House.	Market.	Saloon or Restaurant.	Cask of Lime.
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	$4 00	-	$4 00	-	$3 00	$2 00	-	-	-	$4 00	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
$2 50	$1 25	2 50	$2 00	2 50	$1 00	2 50	2 00	$1 00	$1 50	$4 00	5 00	-
5 00	2 00	3 00	2 00	5 00	2 50	5 00	4 00	1 50	3 00	8 00	10 00	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
5 00	50	3 00	2 00	4 00	1 50	2 50	-	-	-	6 00	10 00	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
*–	*–	*–	*–	*–	*–	*–	*–	*–	*–	*–	*–	*–
-	-	-	-	-	-	-	-	-	-	-	-	-
7 00	-	4 00	2 00	4 00	2 00	4 00	2 00	-	-	-	4 00	-
-	-	-	-	-	-	-	-	-	-	-	-	-
8 00	-	4 00	2 00	4 00	2 00	-	4 00	2 00	-	-	-	-
5 00	-	-	-	2 00	1 00	-	2 00	1 00	8 to 15	7 to 10	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
5 00	2 50	6 00	4 00	6 00	2 00	6 00	5 00	3 00	3 00	6 to 25	6 to 25	-
7 50	2 50	5 00	2 00	5 00	2 00	5 00	5 00	2 00	-	-	-	$0 08
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
10 00	-	-	-	-	-	-	-	-	-	-	-	-
6 00	-	3 00	1 00	4 00	2 00	3 00	4 00	2 00	-	-	10 to 25	06
6 00†	-	-	-	-	-	-	-	-	-		-	
6 00	2 00	5 00	3 00	5 00	3 00	6 00	3 00	2 00	-	6 to 25	6 to 25	-
-	-	-	-	-	-	-	-	-	-	-	-	-

* Same as Lynn. † Measured water 15 to 50 cents per 1,000 gallons.

Name of Water Works Company, etc.	Cost of Works.	Water Rights and Damages.	Water Debt.	Sinking Fund.
Norfolk County.				
Fifteen supplies; four returns.				
Brookline Water Works, . . .	$807,703 00	$30,958 00	$651,000 00	-
Canton Water Works, . . .	125,000 00	-	-	-
Franklin Water Works, . . .	128,241 81	-	-	-
Hyde Park Water Company, . .	180,000 00	-	100,000 00	-
Plymouth County.				
Eight supplies; two returns.				
Hingham Water Company, . .	260,000 00	8,000 00	-	-
Whitman Water Works, . . .	83,000 00	-	75,000 00	$5,000 00
Suffolk County.				
Three supplies; no returns.				
Worcester County.				
Twenty-three supplies; four returns.				
Brookfield Water Works, . . .	17,000 00	250 00	-	-
Fitchburg Water Works, . . .	634,996 54	-	500,000 00	166,446 57
Grafton Water Company, . . .	-	-	80,000 00	-
Leominster Water Company, . .	179,524 62	-	150,000 00	-
Slater Woolen Company (Webster),	36,000 00	-	-	-

Water Rates.

One Faucet.	Additional Faucet.	Bath Tub.	Additional Tub.	Water Closet.	Additional Water Closet.	Hose.	Stable, one Horse.	Additional Horse.	Boarding House.	Market.	Saloon or Restaurant.	Cask of Lime.
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
$8 00	-	$4 00	$2 00	$4 00	$2 00	$5 00	$5 00	$1 00	$13 to 20	-	-	$0 05
*	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	-	-	-	-	-	-	-	-	-	-
6 00	$2 00	5 00	3 00	5 00	3 00	5 00	5 00	2 00	2 50	$6 00	$6 00	-
8 00	2 00	5 00	3 00	5 00	3 00	6 00	6 00	3 00	3 00	6 to 10	6 to 10	05
-	-	-	-	-	-	-	-	-	-	-	-	-
5 00†	75	2 50	1 75	3 to 5	1 75	5 00	3 00	1 25	7 00	3.50 to 40	-	-

* Measured water 15 to 30 cents per 1,000 gallons.

† Measured water 9 to 25 cents per 1,000 gallons.

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INDEX.

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